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Akademiya Nauk SSSR

FAUNA OF THE U.S.S.R.

DIPTERA

Volume III No. 4

A. V. Gutsevich, A. S. Monchadskii, and
A. A. Shtakel'berg

Mosquitoes

Family *Culicidae*

TRANSLATED FROM RUSSIAN

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FAUNA OF THE U.S.S.R.

(Fauna SSSR)

DIPTERA

(Nasekomye dvukrylye)

Volume 3, No.4

A. V. Gutsevich, A. S. Monchadskii, and A. A. Shtakel'berg

MOSQUITOES
Family *Culicidae*

Chief Editor: B.E.Bykhovskii
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O.A.Skarlato, and A.A.Strelkov (Volume editor)

Izdatel'stvo "Nauka"
Leningradskoe Otdelenie
Leningrad, 1971

Translated from Russian

Israel Program for Scientific Translations
Jerusalem 1974

The Publication of this Translation
was Supported by
THE UNITED STATES–ISRAEL
BINATIONAL SCIENCE FOUNDATION

Copyright © 1974
Keter Publishing House Jerusalem Ltd.
Cat. No.61014 4

ISBN 0 7065 1475 0

Translated by Rose Lavoott
Edited by Prof. O. Theodor

Printed in Jerusalem by Keter Press
Binding: Wiener Bindery Ltd., Jerusalem

Available from the
U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
Springfield, Va. 22151

IV/7/3

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PREFACE

Volumes on mosquitoes have been published in the series "Fauna of the U.S.S.R." by A.A. Shtakel'berg, 1937, Family Culicidae (Bloodsucking Mosquitoes of the Palaearctic Region) and in the series "Keys to the Fauna of the U.S.S.R." by A. S. Monchadskii, 1936 and 1951, Larvae of Bloodsucking Mosquitoes of the U.S.S.R. and Adjacent Countries. Data from these volumes, and original research and material from the literature in the years after the publication of the above works, have been included in the present volume.

The large collections in the Zoological Institute of the Academy of Sciences of the USSR (ZIN) form the basis of our work. We are deeply indebted to all those who sent additional material to the Institute and who are too numerous to list.

To avoid lengthiness and to facilitate the use of the keys, we have included 85 species which occur in the Soviet Union and also 9 Palaearctic species of Aedes which are vectors of diseases or species which probably occur in the USSR.

The authors did not want to burden the book with specialized data or lengthy descriptions. The characters given are mainly of diagnostic importance. Only a few of the most common synonyms have been given. References have been cut to the minimum (only the more important and recent publications). The authors of the numerous works on which the geographical distribution of the species of mosquitoes is based could not be listed.

Most of the illustrations are taken from the books mentioned above; some have been redrawn, and others borrowed from sources which have been acknowledged.

We express our gratitude to E. A. Afanas'eva, T. A. Lyakhtinen and K. G. Fedorova for their long years of work spent in making the preparations, and in arranging and preserving the collection of mosquitoes at the Zoological Institute.

January 1968

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7 *MORPHOLOGICAL DESCRIPTION*

ADULT MOSQUITOES

The lateral surfaces of the usually spherical head are nearly completely occupied by the large, compound eyes which are situated close together or are contiguous in the upper and lower part of the head and are usually kidney-shaped. The number of ommatidia of one eye is 300–1,000. The size of each ommatidium is usually slightly greater in females than in males, and the number of ommatidia is therefore slightly larger in males.

The clypeus is situated in the anterior part of the head before the base of the antennae, and the vertex above the antennae between the eyes. The posterior part of the head is named the occiput.

The antennae are situated close together on the anterior part of the head (Figure 2). The number of antennal segments is 15 in both sexes. The first segment (scape) is ring-shaped or plate-shaped. The second segment (torus) is relatively large, especially in the male, and more or less spherical. It contains the organ of Johnston, which is the organ of hearing. Its structure 9 varies in the different genera (Risler, 1955). The other 13 segments form the flagellum. These are generally of the same type, almost cylindrical and more or less of the same length, except the last segments in the male which are much longer. The hairs on the antennae form rosettes and are much denser and longer in the male (Figure 2, C). The hairs of some antennal segments form hornlike appendages in the males of some groups (subgenus Lophoceratomyia of the genus Culex).

The antennal hairs, which are of various structure and function, are sensillae of different types. There are 5 types of hairs on the antennae of Aedes aegypti (Slifer and Sekhon, 1962). The thick-walled hairs are mechanoreceptors, the thin-walled hairs with numerous small openings are chemoreceptors. Openings in the walls of the hairs are visible under the electronic microscope.

The buccal organs form a proboscis (Figure 2). The proboscis of the female consists of a labrum, a pair of mandibles, a pair of maxillae, a hypopharynx and a labium. The labrum forms a canal through which liquid food enters the intestine. The hypopharynx has a canal through which the saliva flows out during bloodsucking. In the resting state, all these parts are situated in the groove of the labium.

Females of all Palaearctic mosquitoes, except Toxorhynchites, feed on plant juices and the blood of vertebrates. When sucking blood, the piercing parts penetrate the skin. The labium becomes folded in two and remains outside (Figure 2). The piercing parts move in different directions in the skin and penetrate a capillary, and then bloodsucking begins. Sucking of blood extravasated from the capillary is also possible. Bloodsucking lasts slightly longer in this case.

(7)

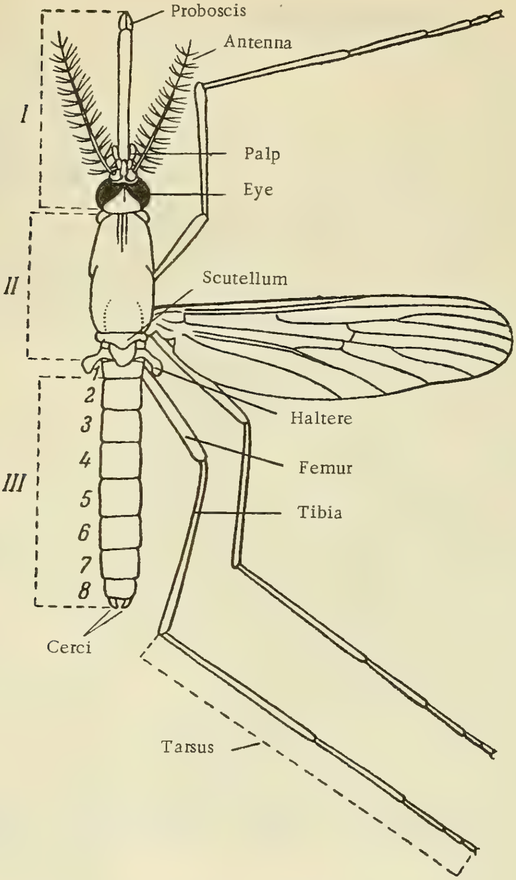
Proboscis
Antenna
I
Palp
Eye
II
Scutellum
1
2
3
4
III
5
6
7
8
Haltere
Femur
Tibia
Cerci
Tarsus

FIGURE 1. Structure of the mosquito:

I – head and its appendages; II – thorax; III – abdomen; 1–8 – segments of abdomen.

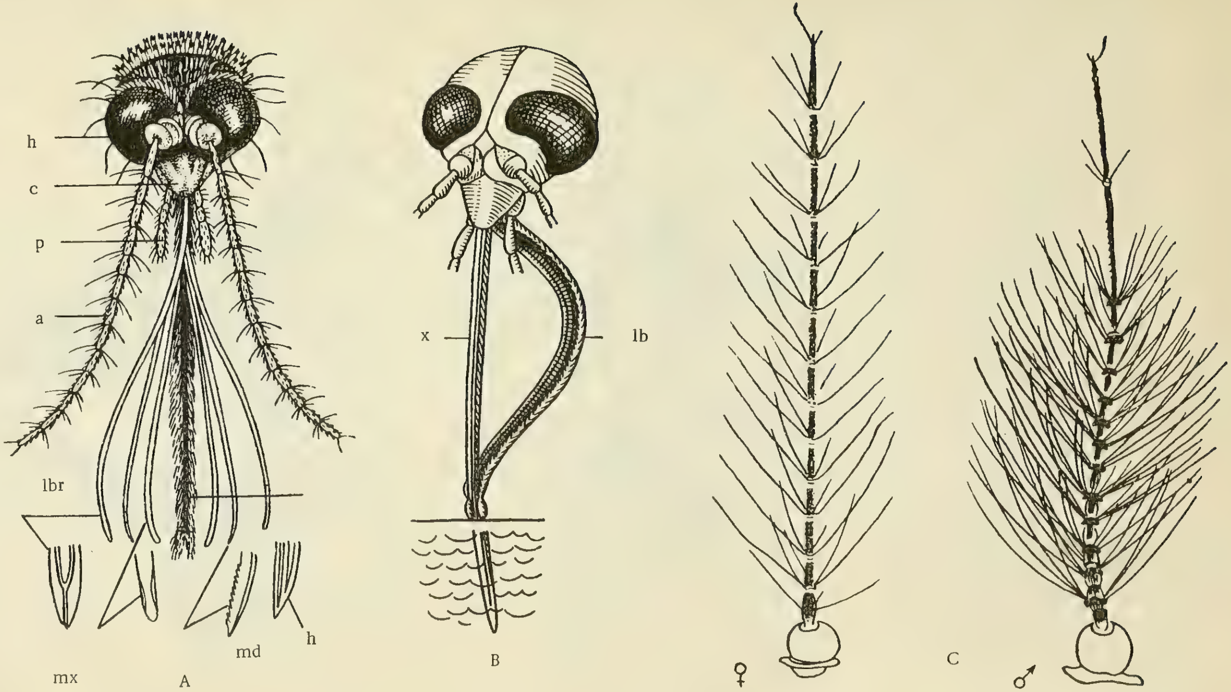

FIGURE 2. Head and its appendages:

A—head with spread proboscis; B—proboscis at the beginning of bloodsucking (after Pavlovskii); C—antennae (after Christophers); h—head; c—clypeus; p—palp; a—antenna—lbr—labrum; md—mandible; mx—maxilla; h—hypopharynx; lb—labium; x — piercing part of proboscis.

Male mosquitoes do not suck blood. Their proboscis differs from that of the female in the absence or reduction of the mandibles and maxillae. The degree of reduction of the mandibles and maxillae varies in males of different genera (Marshall, 1938).

At the sides of the proboscis are the maxillary palps; these are segmented appendages which are long in both sexes of Anopheles and usually in the males of other genera, but are very short in the females of Culicinae, in the males of Uranotaenia and in the subgenus Aedes (Palaearctic species). The palps consist of 5 segments but segment 5, sometimes also segment 4, may be absent or form a small rudiment.

Thorax

The thorax (Figure 3) is divided into 3 parts: prothorax, mesothorax and metathorax, each of these forming a ring which consists of several sclerites. The dorsal sclerites form the mesonotum, the lateral sclerites the pleurae of the thorax. The largest part is the mesothorax, in which the wings are situated. The dorsal surface of the thorax, the mesonotum, is uniformly convex. In the median line of the mesonotum extends a row of setae, the acrostichals, and lateral to them, in about the middle between the median line and the lateral margins, there is also a longitudinal row of setae, the dorsocentrals. Behind the mesonotum is the scutellum, which is 3-lobed in the Culicinae, uniformly rounded in Anopheles. Below the scutellum and behind it is the postnotum.

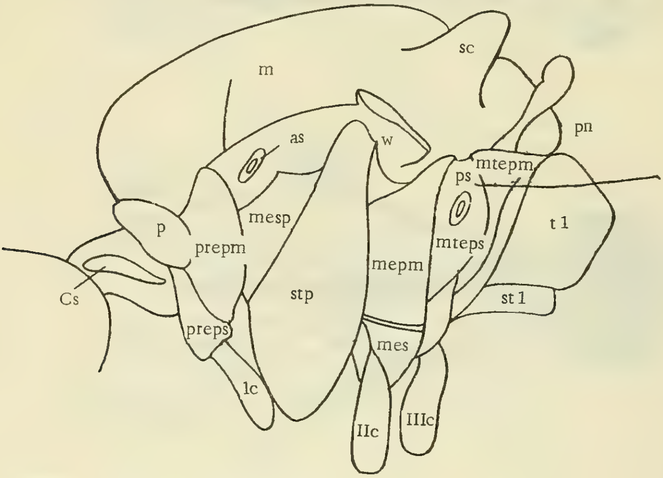

FIGURE 3. Thorax of mosquito, lateral:

CS — cervical sclerite. Prothorax: p — pronotum; prepm — proepimeron; preps — proepisternum. Mesothorax: m — mesonotum; sc — scutellum; pn — postnotum; as — anterior spiracle; mesp — mesepisternum (dorsal part); stp — mesepisternum (ventral part — "sternopleuron"); w — attachment of wing; mepm — mesepimeron; mes — meron. Metathorax: ps — posterior spiracle; mteps — metepisternum; mtepm — metepimeron. Legs: Ic, IIc, IIIc — coxae. Abdomen: t1 — tergite 1; st1 — sternite 1.

The lateral parts of the thorax (pleurae) also consist of several sclerites separated by sutures. The lateral sclerites of each segment are divided into two parts: episternum (anterior part) and epimeron (posterior part). In lateral view, the thorax consists of the following parts (Figure 3): pronotum and episterna and epimera of the mesothorax. The mesothorax of mosquitoes is divided into two parts: a small anterior dorsal and a large ventral part. The ventral part is wedged in the form of a triangle between the base of the fore and mid-legs and is called "sternopleuron." Further posteriorly are the epimera of the mesothorax (mesepimera) and the episternum and epimeron of the metathorax. The membranous area between the base of the fore legs and the anterior ventral margin of the sternopleuron is called the postcoxal area. The arrangement of the scales on the pleurae, particularly on the proepimeron, sternopleuron and mesepimeron, are important in the systematics of mosquitoes, especially in the genus Aedes.

(11)

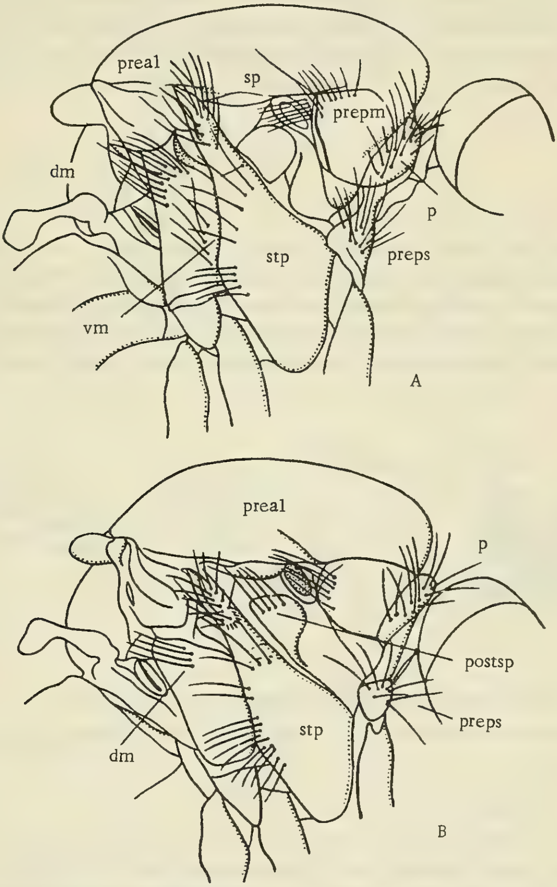

FIGURE 4. Arrangement of setae on the pleurae:

A — Culiseta; B — Aedes; p — pronotal; preps — proepisternal; prepm — proepimeral; sp — spiracular; postsp — postspiracular; preal — prealar; stp — sternopleural; dm — dorsal mesepimeral; vm — ventral mesepimeral.

Between the epimeron of the prothorax, the episternum of the mesothorax and lateral margin of the mesonotum is situated the anterior spiracle. At the border of the epimeron of the mesothorax and episternum of the metathorax is the posterior spiracle. The spiracles are important because not only air passes through them into the tracheae but water is
11 evaporated. It has been shown experimentally in Anopheles maculipennis that evaporation takes place at the surface of the tracheae (Vinogradskaya, 1953). The size of the spiracle depends on the intensity of evaporation. In mosquitoes living in arid zones, the spiracles are smaller than in mosquitoes in humid climates. An index of the size of the spiracle is the spiracle index, the ratio between the length of the anterior spiracle and the length of the thorax, expressed in percentages (Vinogradskaya, 1950).

Near the spiracles and in other parts of the pleurae are groups of setae the arrangement of which is constant and distinct in many groups of the family. The arrangement of the setae is denoted as follows (Figure 4): pronotal (on the pronotum); proepisternal; proepimeral; spiracular (immediately before the anterior spiracle, between it and the margin of the proepimeron); postspiracular (behind the anterior spiracle in the dorsal part of the mesepisternum); sternopleural; dorsal and ventral mesepimeral.

Legs

There are 3 pairs of legs on the thorax — fore, mid- and hind legs, situated on the prothorax, mesothorax and metathorax. The legs consist of the following parts: a short coxa articulated with the thorax; the trochanter, which forms a small ring; the femur, which forms a long cylinder which is sometimes slightly thickened at the base; the tibia, also long, slender and cylindrical; the 5-segmented tarsus with paired claws at the end (Figure 5).

(12)

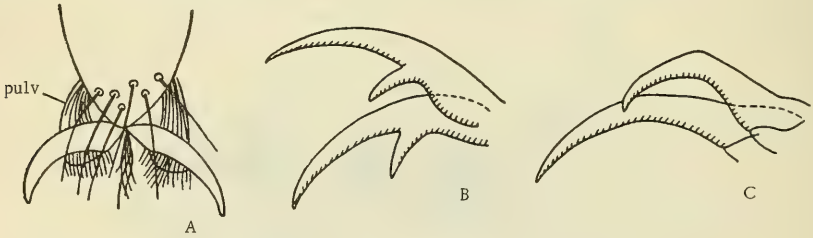

FIGURE 5. Terminal appendages of the tarsus (from E. N. Pavlovskii):

A—praetarsus of Culex; B—claws of a female of Aedes; C—claws of a female of Culex; pulv —pulvilli.

On the ventral, concave side of the claws there may be 1 or 2 denticles. The arrangement of the claws is expressed by the formula 2.1; 2.1; 1.1, i.e.: one claw of the anterior tarsus has 2 denticles, the other one denticle;
12 the claws of the mid-tarsus are the same; both claws of the hind tarsi have one denticle. The formula 0.0; 0.0; 0.0 indicates that all claws are simple.

The structure of the claws differs in different species (particularly in the genus Aedes), and this character is therefore important in the determination of some mosquitoes (Vockeroth, 1950, Sazonova, 1958). The form of the claws is nearly the same on all legs but the size of the claws decreases from the fore to the hind legs, and the claws of the fore tarsus are therefore mainly used.

There are pulvilli, small, oval plates covered with hairs (Figure 5), under the claws in some genera. Between the claws is a single structure, the empodium, which often forms a feathered or branched seta.

The following should be remembered about the topography of the legs. The articulation of the coxa, trochanter and femur is multiaxial so that it may occupy different positions with respect to the main axis of the body. Thus, for a convenient orientation, the knee or the monaxial articulation of femur and tibia should be used. If the knee is bent, the femur and tibia face each other with the ventral surface. If the leg is extended horizontally and laterally this surface is ventral and the opposite surface dorsal. The surfaces perpendicular to these surfaces are the anterior and dorsal surfaces.

Wings

The wings are usually elongate-oval and supported by longitudinal veins and cross veins. The point of attachment of the wings to the thorax is their base. The distal end of the wings is the apex. When the wings are spread (i.e. when the long axis of the wing is perpendicular to the longitudinal axis of the body), the margin of the wing which is directed anteriorly forms the anterior margin and the opposite margin the posterior.

(13)

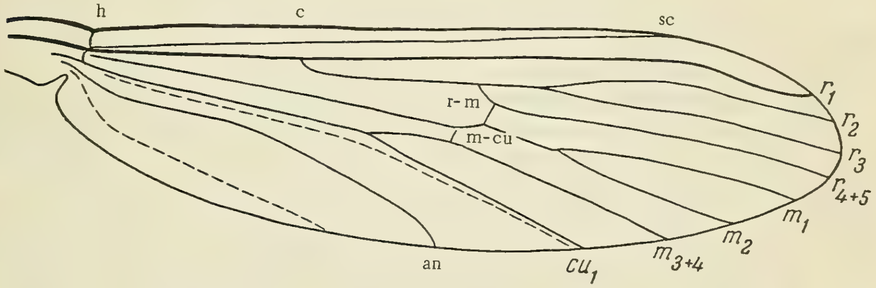

FIGURE 6. Wing of Culex:

Veins: c — costa (marginal); sc — subcosta; r_1, r_2, r_3 r_{4+5} — radius; m_1, m_2, m_{3+4} [or cu_1] — media; m_1 [or cu_2] — cubitus; an — anal, r-m — anterior cross-vein; m-cu — posterior cross-vein; h — humeral.

The longitudinal veins are named as follows (Figure 6): costa, or marginal vein (c) along the outer margin of the wing (it is present along the anterior and posterior margin in the mosquito); the next vein is the
13 subcosta (sc), which begins at the base of the wing, extends nearly parallel to the anterior margin and ends in the costa in the apical third of the wing. Then follows the radius, which in the mosquito always has 4 branches (r_1, r_2,

r_3, r_{4+5}; r_{4+5} indicates that this vein has been formed by the fusion of r_4 and r_5, which are present separately in some primitive forms related to mosquitoes). The radius begins in a common stem at the base of the wing, the radial veins then branch and the stem $r_2 + r_3 + r_{4+5}$ branches from r_1; from it branches r_{4+5}; branches r_2 and r_3 form the anterior or radial fork of the wing; section r_{2+3} from the cross-vein to the base of the fork is called the stem of the radial fork. The next vein is the media (m); in the Culicidae it has 3 branches – m_1, m_2 and m_{3+4};* the first two branches form the median fork, the last branch together with the cubitus (cu) forms the posterior fork in the apical part of the wing. The posterior longitudinal vein is called the anal vein (an).

There are three cross-veins: the humeral (h), between costa and subcosta near the base of the wing, the radio-medial (r–m) between the radius and media in the middle of the wing, and the medio-cubital or posterior cross-vein (m–cu) between media and cubitus.

The longitudinal veins and the cross-veins form cells which are named after the veins anterior to the cell. The veins are indicated by lower-case letters, the cells by capitals, e.g. R_1, M, Cu, An.

The veins are covered with scales which are more densely arranged in the female. The scales on the veins are usually narrow, linear or lanceolate, rarely wide, e.g. in the genus Mansonia. The wing membrane is covered with minute hairs – microtrichia – that are visible only under the microscope.

The club-shaped appendages of the metathorax are characteristic for the Diptera; these are the halteres, which are the rudiments of the posterior
14 pair of wings. The halteres function as a gyroscopic organ for the maintenance of equilibrium. There are two groups of sensillae at the stem of the halteres.

Abdomen

The abdomen of mosquitoes is usually elongate-cylindrical and consists of 10 segments; the last two segments are markedly modified and included in the genitalia. The first eight segments consist of a dorsal sclerite, the tergite and a ventral sclerite, the sternite; they are connected by the pleural membrane on which the abdominal spiracles are situated on segments 2–7. In the young female with undeveloped ovaries, the lateral margins of the tergites are curved ventrally and are not visible in dorsal view. The membrane connecting the tergites with the sternites forms folds. The abdomen of a dry mosquito has the same appearance. After feeding and the development of the ovaries, the tergites become straightened and the pleural membranes distended.

Segments 9 and 10 form the genitalia. The male genitalia (Figures 7–9), the hypopygium, are of complicated structure, different in every species. The structure of the genitalia is therefore of great importance in the systematics of mosquitoes. The species of a mosquito can often be determined with certainty only by the structure of the genitalia. There is no uniform nomenclature of the parts of the genitalia.

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* [In the usual interpretation the media is 2-branched and the cubitus 2-branched.]

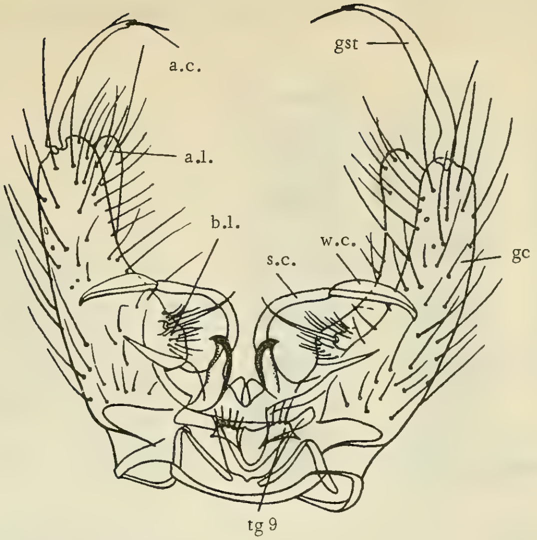

FIGURE 7. Hypopygium of Aedes:

gc — gonocoxite (coxite); gst — gonostyle (style); a.c. — apical claw; a.l. — apical lobe; b.l. — basal lobe; s.c. — stem of claspette; w.c. — wing of claspette; tg 9 — lobes of tergite 9.

The hypopygium of males is rotated through 180° after hatching so that tergite 9 is then situated ventrally and sternite 9 dorsally. The terms "tergite" and "sternite" are kept for the morphologically dorsal and ventral sclerites of segment 9.

Segment 9 consists of a dorsal and a ventral sclerite. The true tergite 9 is a narrow sclerite at the sides of which, at the posterior margin, are processes named lobes of tergite 9. They usually bear setae or hairs at the apex. In some species of Stegomyia, the tergite has a median, conical or tongue-shaped lobe in addition to the lateral lobes. The true sternite 9 is usually a narrow strip which sometimes bears lateral processes.

The largest part of the hypopygium is formed by the gonopods (valves), which are paired formations. Each gonopod consists of 2 segments, the gonocoxite and the gonostyle. These parts will be named simply coxite and style. The coxite is a large formation which usually has an apical and a basal lobe on the inner side (in most species of Aedes, Figure 7). There is sometimes a lobe in the middle of the coxite (Culex, Culiseta) or near the apex, as in the genus Culex (Figure 8). The inner side of the coxite usually bears spines or 1—3 large setae, the position, structure and number of which are characteristic for some species, particularly in the genus Anopheles (Figure 9). The spines, if present, are usually situated on the basal lobe in Aedes. The coxite is covered with hairs or scales on the outside, dorsally and ventrally.

At the apex of the coxite or slightly subapically (subgenus Aedes and others) is situated the narrow, movable style, which is sometimes widened.

At the apex of the style is a finger-shaped or spine-shaped claw which is sometimes very short.

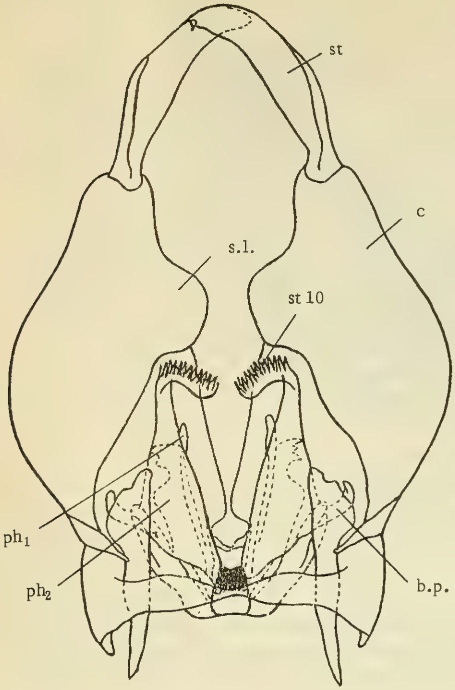

FIGURE 8. Hypopygium of Culex:

st – style; c – coxite; s.l. – subapical lobe; ph_1, ph_2 – first and second part of phallosome; st 10 – sternite 10; b.p. – basal process of sternite 10.

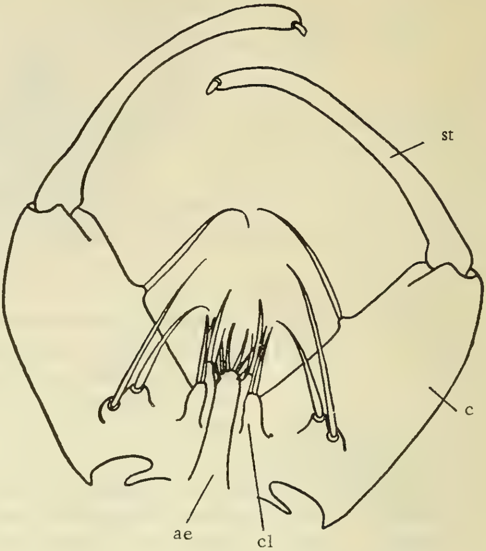

FIGURE 9. Hypopygium of Anopheles (after Coe, Freeman and Mattingly):

st – style; c – coxite; cl – claspettes; ae – aedeagus.

16 Inside of the coxites are the claspettes, which are processes of the basal part of the coxite. The claspettes are completely developed only in some groups; a special development is present in the subgenera Ochlerotatus and Finlaya of the genus Aedes in which the claspettes are 2-segmented formations consisting of a basal part, the stem, and an apical part, the wings, the form of which varies in different species. There may be a transparent, platelike widening at the convex side of the wings. Claspettes are absent in Culex and other genera.

Near the median line are the sclerites of the 10th (anal) segment which surround the anus. Tergite 10 is usually represented by 2 small sclerites which are connected with sternite 10 at the apex. Sternite 10 (paraproct) usually consists of two distinct, elongate sclerites which are sometimes covered with short hairs, especially in Culex, in which the spines or denticles at the apex of sternite 10 and the development of its basal process are characteristic. The sclerotized apex of each sclerite of sternite 10 forms a simple or denticulate claw.

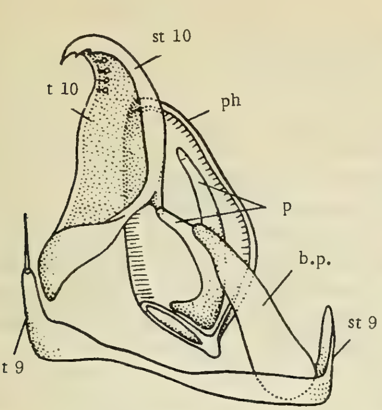

FIGURE 10. Inner sclerites of the hypopygium of Aedes, lateral (after Matheson):

t 9 – tergite 9; st 9 – sternite 9; t 10 – tergite 10; st 10 – sternite 10; ph – phallosome; p – parameres; b.p. – basal plate.

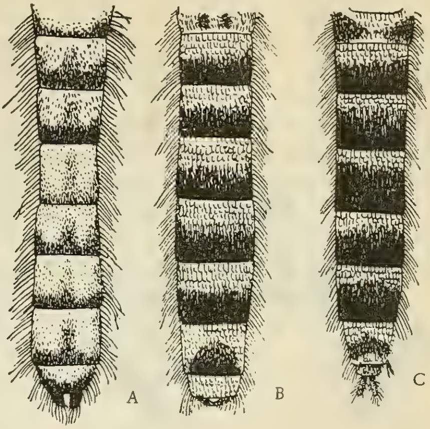

FIGURE 11. Abdomen of female (after Coe, Freeman and Mattingly):

A – Anopheles; B – Culex; C – Aedes.

The organ of copulation is the aedeagus (Figure 10), a complicated formation which consists of several sclerites: lateral sclerites, parameres and phallosome (mesosome). The phallosome of Culex is very complicated and usually consists of 2 parts which are divided into several denticles. The structure of the phallosome is of great systematic importance.

The terminal segments of the abdomen of the female are relatively little 17 modified. Sternite 8 is usually simple. In the subgenera Stegomyia and Finlaya of the genus Aedes it attains a high degree of development. At the end of the abdomen are the paired cerci (Figure 11, C). They are sometimes distinctly developed as two small, elliptical sclerites, sometimes more or less covered. The development of sternite 8 and of the cerci in groups of the genus Aedes are characters connected by reverse correlation.

In cleared preparations of the posterior end of the abdomen of the female, spermathecae in the form of sclerotized capsules are visible in segments 7–8. Their number varies: there may be one (Anopheles, Uranotaenia and rarely in some species of Aedes), two (some species of Mansonia) or three (most Culicinae).

The structure of the female genitalia is not very important in the systematics of mosquitoes, but is quite characteristic for some genera and subgenera (La Casse and Yamaguti, 1955).

The structure of the cutaneous appendages is important in systematics. These appendages are scales (elongate, rarely broad, longitudinally striated), spines (thick setae, for example at the basal lobe of the coxite, in definite numbers in each species), setae (thinner than spines), and hairs.

EGGS

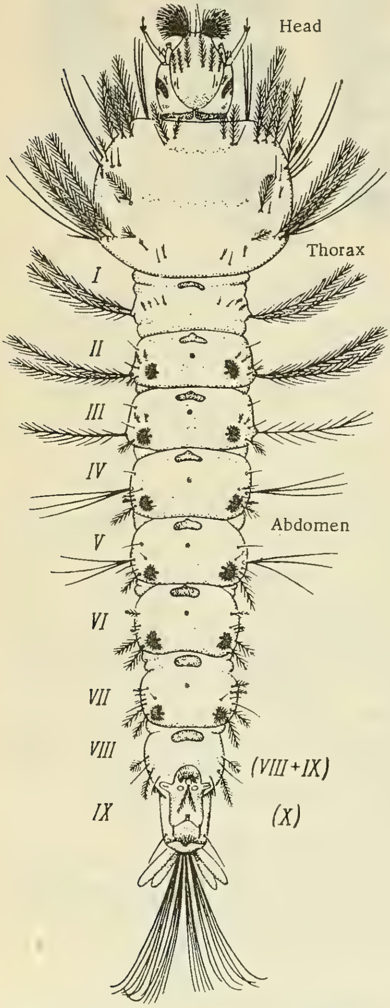

FIGURE 12. Larva of Anopheles, dorsal. Roman figures — segments of abdomen. In parentheses — primitive segments.

The female of Anopheles deposits her eggs singly on the surface of the water, and they may form geometric patterns. The females of Culex, Mansonia and the subgenus Culiseta deposit the eggs in compact rafts, the form of which is determined by the space between the crossed posterior legs of the mosquito. In Aedes and in the subgenus Culicella of the genus Culiseta, the eggs are usually deposited on moist soil, in depressions where they may remain dry for a long time. The larvae hatch after the site of oviposition has become flooded (after rain or thawing of snow). The diapause in the egg is sometimes very long, especially in species of Aedes.

The eggshell consists of three layers. The inner layer is a thin, vitelline membrane which encloses the egg cell with yolk. The next layer is the chorion, which consists of two layers: a median layer, the endochorion, which is hard and opaque, and an outer layer, the exochorion, which is usually soft and transparent. On the exochorion are sculptural patterns which are characteristic for some genera and species.

At the anterior end of the eggs (Culex, Aedes) or slightly subapically (Anopheles) is the micropyle, which permits the entry of the spermatozoa into the egg and fertilization. It consists of a rosettelike membrane surrounded by the exochorion which forms an annular ridge. In the center of the rosette is an opening with a canal leading
18 inside; the canal is covered inside with a plug which opens only when the sperm enters.

The eggs of Culicinae are oblong-oval or nearly cylindrical with a wider anterior end and a narrower, blunt posterior end. The surface often (Aedes and others) has a reticulate, polygonal pattern. The reticulation is narrower in Culiseta and much wider in Mansonia.

The eggs of Anophelinae are boat-shaped, with slightly concave upper and convex lower surface. They are usually surrounded by a narrow fringe which is interrupted in the middle by larger air floats with a varying number of cells in the different (19) species. In Anopheles maculipennis sacharovi, the eggs of summer generations have only a fringe and small air floats in addition to the fringe in winter. The pattern of the exochorion of the upper surface of the eggs, especially in the subgenera of A. maculipennis, is important in systematics (see pages 97 and 98).

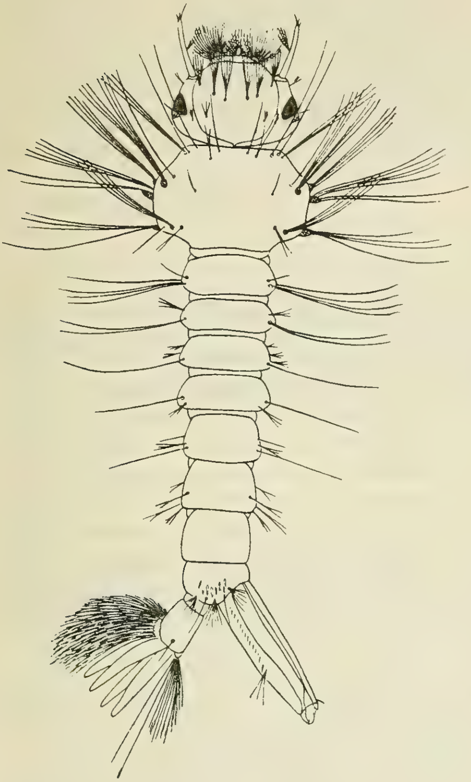

FIGURE 13. Larva of Aedes cinereus. Lip.

LARVA

The body of the larva consists of three parts (Figures 12 and 13): the head, which is enclosed in a sclerotized capsule, the thorax, which consists of 3 fused segments, and the abdomen, with 9 segments. The last segment is curved ventrally and at its end is situated the anus, surrounded by 2 pairs of gills. On the ventral side of the last segment is the organ of movement, the fin or ventral brush. On the dorsal side of segment 8 of larvae of Anopheles is the only functional, posterior pair of spiracles surrounded by a valvular apparatus which forms a stigmatical plate; in the larvae of Culicinae, the posterior pair of spiracles with the stigmal plate is situated at the end of the siphon, which is situated on the dorsal side of segment 8. The thorax is the widest part. The abdominal segments are narrower.

The 4th-stage larvae are 0.5–0.7cm long or small species (Uranotaenia, some species of Culex) and 1.5cm long or longer in the large species (Culiseta, Aedes, Toxorhynchites, and others).

19 The color of the larvae varies. The cuticle, except the sclerotized parts (head, siphon, etc.), is transparent and colorless and the color of the body depends therefore on the color of the inner organs and tissue, mainly the fat body. The pigment is concentrated mainly on the dorsal side of the

fat body. The inner parts of the fat body are practically without pigment. The dorsal side is always darker than the ventral, which is important for species developing in the spring at low temperatures since the pigment absorbs heat rays and the development of the larvae takes place at more favorable temperatures. The larvae of the same species are therefore more strongly pigmented in the north than in the south.

The larvae of Toxorhynchites and Orthopodomyia are wine-red. The larvae of Ochlerotatus and Culiseta are light to dark brown or blackish; the larvae of Mansonia are yellowish; those of Culex light brown or grayish green. Many larvae which are transparent in the early stages become bluish green (C. territans) in the 4th stage. Greenish shades (yellowish green to brownish green) are characteristic for 4th-stage larvae of Anopheles; the earlier stages are nearly black.

Hairs of the body

The body of the larva is covered with numerous, different hairs. The longer hairs together form an extensive sensory zone around the body. They sense the slightest disturbance of the water caused by predators and induce the larva to change its position. Especially long hairs are present in larvae (Aedes alektorovi, Orthopodomyia pulchripalpis, and others) which live in tree holes, where they are so crowded and food is so scarce that cannibalism often occurs. In larvae of other species living in tree holes, the hairs are short and form spines (Toxorhynchites, Aedes geniculatus, A. echinus, A. galloisi, etc.). Larvae living on the surface of the water (Anopheles) have short or specially modified hairs on the dorsal side and strongly developed lateral hairs, while larvae with a submerged mode of life have more or less uniformly developed hairs on all sides.

Two types of cuticular formations are especially important.

The first type are various sculptured appendages of the cuticle: small spines (chaetoids) which often cover the body densely (Aedes cyprius, Culex hortensis); short, pointed spines on the antennae or at the posterior margin of the saddle of the last abdominal segment which form combs; microscopic spines on the siphon, and others. This type of formation includes the scales of the comb at the sides of segment 8 and the denticle of the pecten on the siphon since there are all transitions between them and the typical, small spines of the chetoid type. All these formations are very variable in number; the more specialized denticles of the pecten and the scales of the comb are less variable.

The second type are the true hairs. Each hair is hollow with slightly widened base situated in a cup-shaped, articulated pit which forms a ring around the base. The cuticle surrounding the ring may be thickened in the form of a dark sclerite which sometimes encloses a group of hairs near it (Toxorhynchites, Anopheles, etc.) or it forms a tubercle with processes (lateral hairs on thorax and abdominal segments). These hairs are often of systematic importance. Their position and number are constant not only in larvae of the same species but often also in the genus or in the whole family. The structure of the hairs and their branching are very different and often variable. Stronger branching of a hair in the same species is connected with the delicacy of its branches and vice versa.

In the simple cases, the hairs form a long stalk which tapers apically; its surface may be smooth or bear secondary feathering; these secondary hairs may be short or long or situated on the same plane (Anopheles). The hairs may be divided at the end to a greater or lesser degree. The second group consists of branched hairs which may have a short stalk and then branch dichotomously, dendriform, irregularly (outer clypeal hairs of Anopheles) or form a fan on a short base. In some cases the branches are not situated in the same plane but in a circle, like the margin of a polyhydral pyramid (Aedes geniculatus and others). The hairs may be compressed and each branch is oblong, leaf-shaped (palmate hairs of Anopheles, Figure 22). All hairs situated in one basal ring should be considered as separate.

In addition to the hairs, the body of the larvae may bear large, dark sclerites of varying form. They are often restricted to areas where muscles are attached (dorsal abdominal plates of Anopheles) or may be important as supports (saddle of last abdominal segment, plates at sides of segment 8 in Uranotaenia and others). These plates together with the spines often protect the larvae from predators (Orthopodomyia, Toxorhynchites).

21 *Head*

The chitinized capsule of the head has a flattened ventral side and a convex dorsal side. Its form varies from oblong-ovoid (Anopheles, Figure 14) to broadly transverse-oval (Mansonia, Culex, etc., Figure 15). It is nearly rectangular in Toxorhynchites. These forms are connected with the nutrition of the larvae and the characteristics of their mouth parts.

The dorsal side of the head is formed mainly by the large frontoclypeus, which is usually oblong and widest before the eyes. It is nearly square in larvae of Toxorhynchites (Figure 57). The frontoclypeus is laterally and posteriorly bordered by the frontal suture. Before it is situated the clypeus, which is separated from it by the epistomal suture. The form of the clypeus is connected with the structure and function of the labrum: it is narrower in the middle. The anterior part of the frontoclypeus is morphologically the clypeus because the muscles of the labrum originate there and the epipharyngeal musculature originates in its posterior part. The frontal sclerite is therefore really the frontoclypeus and the clypeus the preclypeus.

Lateral to the frontoclypeus are the epicranial plates. They reach to near the median line posteriorly and form the short coronal suture. The epicranial plates extend on the ventral side to the base of the maxillae where the sutures begin which separate the genae from the ventral median sclerite, the gula. The anterior margin of the gula reaches to the base of the labium.

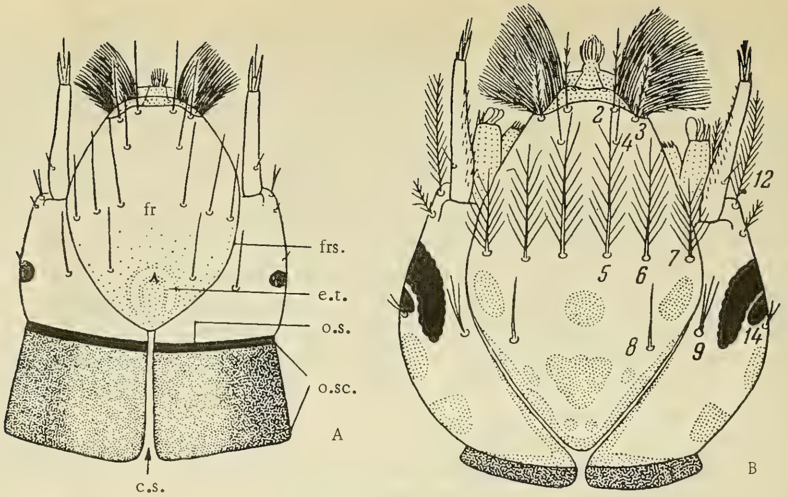

FIGURE 14. Head of larva of Anopheles, dorsal (after Puri):

A – 1st stage; B – 4th stage; fr – frontoclypeus; frs. – frontal suture; o.sc. – occipital sclerite ("collar"); o.s. – occipital suture; c.s. – coronal suture; e.t. – egg tooth; 2, 3 – inner and outer clypeal hairs; 4 – postclypeal hairs; 5–7 – inner, median and outer frontal hairs; 8 – sutural hair; 9 – transsutural hair; 12 – hair at base of antenna; 14 – supraorbital hair.

In the middle of the gula of the 4th-stage larvae of Anopheles and 22 others, especially posteriorly, is a longitudinal suture which does not extend to the base of the labium. During the molt, the head capsule becomes divided along the frontal suture into 3 parts: the frontoclypeus is raised and both epicranial plates are pushed aside (Figure 14).

The posterior margin of the head forms the occipital foramen, which is wide in Anopheles and Toxorhynchites and narrow in other larvae. The foramen is surrounded by a dark, narrow, ring-shaped sclerite (collar). The occipital suture is interrupted dorsally near the coronal suture and ventrally near the median line.

The occipital sclerite of Anopheles changes during development. In larvae hatching from the eggs it is very narrow but in 1st-stage larvae it grows and forms 70% of the length of the head before the molt. This is repeated in the 2nd stage. During the 3rd stage, the length of the collar decreases to 30–32% of the length of the head and in the 4th stage to 11%. This is not observed in larvae of other genera.

In 1st-stage larvae there is an egg tooth in the middle of the posterior margin of the frontoclypeus (Figure 14,A) which facilitates exit of the larva from the egg.

The color of the head capsule varies from pale and semitransparent (Culex) to yellowish brown, dark brown (many Aedes) and black (Culiseta longiareolata, Uranotaenia). If the head is dark, it is more or less of uniform color, if it is light, dark spots which form a characteristic pattern are present on the frontoclypeus and lateral plates, especially posteriorly. These are the points of attachment of the muscles which move the mouth parts and antennae and the dilator muscles of the pharynx

(Figure 14). Places with the most intense mechanical action are more strongly sclerotized. Further strengthening of the head capsule is also attained by the fusion of spots with the formation of dark, curved, transverse stripes in the form of two arcs which strengthen the posterior part of the head. As the pattern of the head becomes darker during development, it is of no importance as a systematic character.

Hairs of the head

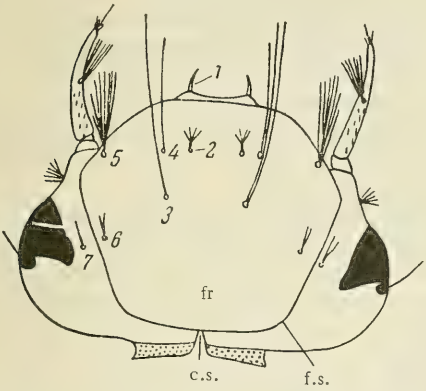

FIGURE 15. Head of a larva of Aedes, dorsal:

fr – frontoclypeus; c.s. and f.s. – coronal and frontal sutures; 1 – setae of clypeus; 2 – postclypeal hairs; 3, 4, 5 – inner, median and outer frontal hairs; 6, 7 – coronal and transsutural hairs.

The head bears about 20 pairs of hairs the number, position and development of which are relatively constant and characteristic for most species. We describe only the main hairs which are important for the determination of the species.

At the anterior margin of the clypeus is a pair of preclypeal setae (Figure 15) which are strong, curved inward, pointed and of varying length and thickness. Behind them are 2 23 pairs of clypeal hairs, an inner and an outer pair, at the anterior margin of the frontoclypeus. These are of great importance for the determination of species of Anopheles larvae and are not present in other genera except in Toxorhynchites. Their arrangement, development and branching (Figure 14) are important in Anopheles larvae.

Some distance behind the clypeal hairs are the postclypeal hairs. They are more weakly developed in Anopheles larvae than the clypeal hairs, and in most other species are very short and situated more posteriorly, usually between the base of the strongly developed frontal hairs (frontal or postantennal). There are three pairs, an outer, a median and an inner pair, and they form a curved row (Anopheles, Culiseta, Mansonia and some species of Aedes and Culex) or the median pair may be situated anterior to the posterior pair forming 2 triangles with their apex laterally. The median hairs are usually more widely separated than the posterior pair (Ochlerotatus, some species of Culex, etc.). The frontal hairs are feathered in Anopheles larvae; they are very short and simple only in A. plumbeus. In the larvae of Culiseta, Mansonia, many Aedes and Culex they are strongly developed and branch from the base in a fan, often with secondary feathering. In other species, they are simple or weakly branched, the outer hairs usually branched more densely than the others.

Behind the frontal hairs are 3 pairs of short hairs: the outer, supraorbital, behind the simple eyes, the median, transsutural, between the inner margin of the compound eyes and the frontal suture, and the inner, sutural, at the sides of the posterior part of the frontoclypeus. The hairs on the ventral side are not of systematic importance.

Eyes

Larvae of the 4th stage have two pairs of eyes, simple (ocelli) and compound eyes. The ocelli are small, rounded pigment spots at the sides of the head where it is widest. These eyes are fully developed and functional only in newly hatched larvae of the 1st stage; they are present in adult mosquitoes but are covered with scales.

The compound eyes are situated at the sides of the head anterior to the ocelli. They are absent in 1st-stage larvae and develop during metamorphosis. In larvae living in weakly illuminated water (tree holes), development and pigmentation of the compound eyes begin later, often in the 4th stage. The eyes function in the larvae because the part of the integument covering the eyes is always unpigmented.

(24)

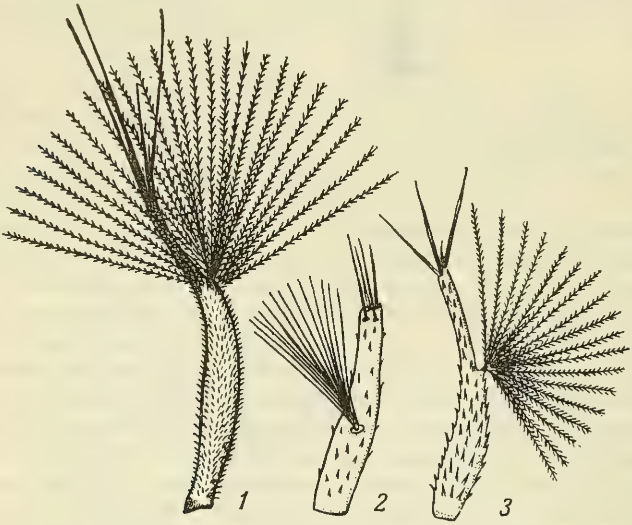

FIGURE 16. Different types of antennae of larvae of Culicinae:

1 – Culiseta morsitans; 2 – Aedes; 3 – Culex pipiens.

The antennae (Figure 16) are one-segmented and are little mobile. Their length is very variable, from $^1/_4 - ^1/_3$ of the length of the head (some species of Finlaya and Stegomyia) to 1.5–2 times as long (Mansonia, Figure 94, Aedes diantaeus, Figure 155). The simplest, short antennae are rod-shaped, slightly tapering toward the apex, and bear the sense organs: hairs and setae. The antenna is smooth, without small spines, and a hair is always present near its middle. The antennae do not extend anteriorly beyond the hairs of the lateral lobes of the labrum.

24 The longer antennae are slightly curved and more distinctly divided into a basal part and a thinner apical part. At the border between them is a hair with more or less long, numerous branches which form a fan, often with secondary feathering. The antenna is covered with sparse or dense spines, especially in the basal part. The terminal hairs and setae form two groups: a terminal group at the apex of the antenna and a subapical group at a varying distance from it (Figure 16). Both groups may be long. This structure is characteristic for the larvae of Culex, Mansonia and others. The antennae are pigmented either uniformly or at the base or also at the apex (Culex and others).

Toxorhynchites larvae have three hairs on the antenna; they bear rounded sense organs resembling the annular organs of some larvae of Tendipedidae.

Mouth parts and feeding of larvae

The structure of the mouth parts of larvae is connected with their method of feeding and their biology. The larvae of Culicidae may be divided into two groups according to this character: phytophagous (omnivorous) and predatory. Feeding on plants is primary.

There are 3 different types of feeding in phytophagous larvae. 1) Feeding on the surface of the water, which is characteristic for larvae of Anopheles and some species of Uranotaenia. 2) Feeding on the substrate by sucking or scraping on encrustations and overgrowths on objects in the water, periphyton, which consists of microorganisms of animal or plant origin. This type is common in species of Aedes, Culiseta and others.
25 3) Filtration-planktonic feeding on suspended particles in the water (bacteria, algae, Infusorian, etc.). This type is present mainly in larvae of Culex, Mansonia, some species of Aedes and Culiseta. Some species are adapted to feed on filamentous algae (Culex bitaeniorhynchus, C. sinensis).

There are all possible transitions between the types of feeding, and larvae of a certain species may use one or another, but one type of feeding usually predominates. Thus, Anopheles larvae which feed on the surface may also feed on the substrate, and cannibalism of some larvae has been observed (A. plumbeus). Larvae with the filtration type of feeding may also feed on the substrate and on the surface. This is observed in typical scrapers.

Predatory feeding and cannibalism of larvae of Culicidae are secondary, and develop much later in species adapted to feeding on plants. In species of different subfamilies and genera the transition of species or groups to predatory feeding has taken place independently and at different times. The larvae of Toxorhynchites and Lutzia in Russia are predatory.

The type of feeding is governed not only by the structure and function of the mouth parts but also by the structure of the antennae, the frontal hairs and other hairs on the head, and even by the structure of the siphon. All these structures form a single, trophic, functional complex of correlated characters which adapt the larvae to one or other mode of feeding. Without giving a detailed description of the mouth parts (see Monchadskii, 1936, 1951), we describe only their main modifications and their connection with the structure of other elements of the trophic functional complex.

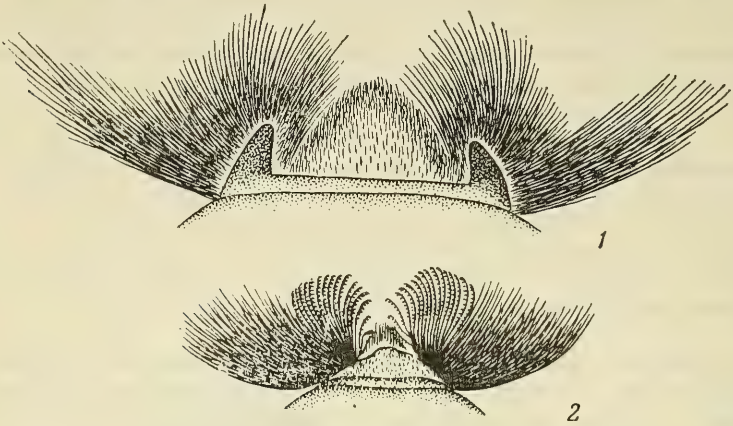

FIGURE 17. Labrum (after Wesenberg-Lund):

1 – *Culiseta morsitans*; 2 – *Culiseta annulata*.

The mouth parts of the larvae consist of the following. 1. The labrum
(Figure 17) consists of a median lobe and two more strongly developed
lateral lobes with the mouth brushes, or flabella, which consist of numerous
flexible, long hairs. This is the main organ which draws the food into the
26 mouth and is used to catch the prey in predaceous larvae. 2. The epipharynx
borders the prebuccal cavity above and is a continuation of the inner surface
of the labrum. It bears symmetrical groups of anteriorly directed hairs,
setae and spines which scrape food particles from the lobe of the labrum
and prevent their return. 3. The mandibles (Figure 18) are strongly
sclerotized, with dark teeth at the distal end of the inner margin and with
27 spines and hairs. During movement of the mandibles, their terminal teeth do
not touch and they have no masticatory function. During accumulation of
the food bolus in the preoral cavity before the hypopharynx, the terminal
teeth break up the bolus into small particles. The hypopharynx serves as
an anvil. The hairs and spines function as in the epipharynx. The bases
of the mandibles border the prebuccal cavity on both sides. 4. The maxillae
(Figure 19) are of a simpler structure; in form, development of palps and
hairs and in their mobility, they vary markedly in the different species.
They border the posterolateral parts of the prebuccal cavity. 5. The labium
is situated between the bases of the maxillae and border the prebuccal
cavity ventrally with the hypopharynx. It consists of 3 overlapping

(26)

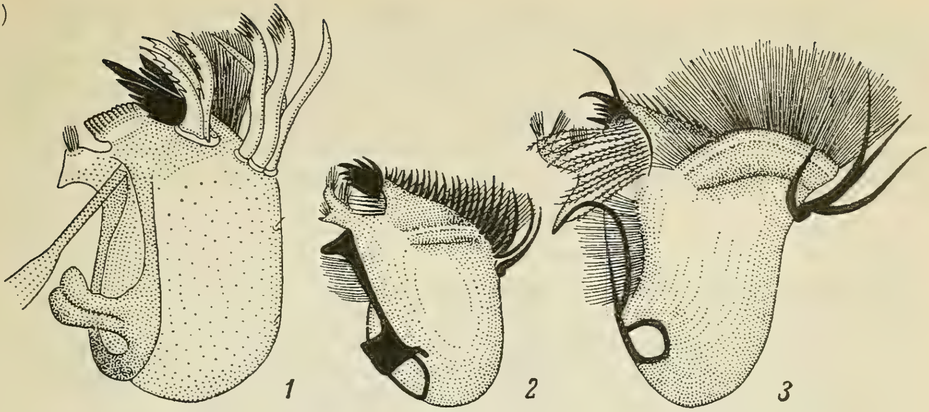

FIGURE 18. Mandible:

1 – Anopheles (after Puri); 2 – Culiseta annulata; 3 – Culiseta morsitans (after Wesenberg-Lund).

(26)

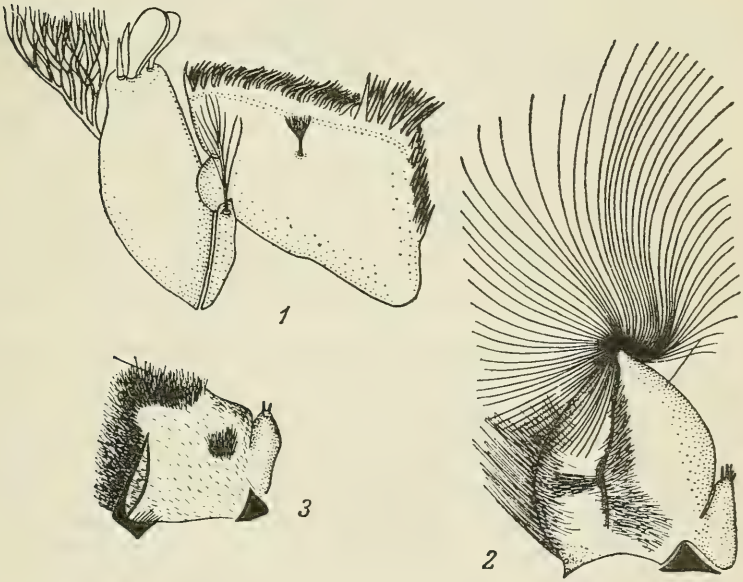

FIGURE 19. Maxilla:

1 – Anopheles (after Puri); 2 – Culiseta morsitans; 3 – Culiseta annulata (after Wesenberg-Lund).

triangular sclerites directed anteriorly, the two inner plates, the mentum and submentum, with denticulate margins and a larger apical tooth. 6. The hypopharynx is situated below the mouth and is separated from the base of the labium by the opening of the salivary ducts. This is a markedly sclerotized sclerite of complicated structure which is covered with tubercles and processes. The accumulation of food is performed by the grinding teeth of the mandibles and then the food enters the pharynx through the mouth.

Metamorphosis of the trophic functional complex

In larvae feeding on the surface (Anopheles), the head is oblong because of the longitudinal arrangement of the muscles of the labrum, the lateral lobes of which move anteroposteriorly during feeding.

During feeding, the head of the larvae is rotated through 180°, supported under the surface of the water by 2 pairs of special formations which are absent in larvae which feed differently: 1) two flattened, knife-shaped setae at the end of the antenna and 2) the large palps of the maxillae which bear a branched lateral hair to increase the area of support and leaf-shaped, flattened sense organs at the apex. The hairs of the lateral lobes of the labrum are not differentiated; they consist of hairs of the same type and length. The mandibles and maxillae receive the food particles which are transported by the labrum, remove them from the hairs and move them to the posterior part of the prebuccal cavity, but their movement is restricted. The row of branched frontal hairs, supplemented by the dendriform outer clypeal hairs (if present) is important in directing the passage of the food particles. The frontal and clypeal hairs of larvae of A. plumbeus, which feed on the substrate, are simple and short. The absence of a siphon ensures close contact of the larva with the surface. In larvae of Uranotaenia which live and feed below the surface, the siphon forms an obtuse angle with longitudinal axis of the body.

During feeding on a substrate which is not flat, the movement of the lobes
28 of the labrum becomes more complicated and the mandibles and maxillae take on a more active role in the procurement of food. The muscles of the labrum are therefore diagonal and the musculature of the jaws becomes stronger.

The lateral parts of the epicranial plates develop more strongly, especially in the posterior part so that the head becomes wider than long. A differentiation of the structure of the hairs of the lateral lobes of the labrum takes place. The apex of the inner hairs becomes more flattened and bears 10–25 denticles which form a comb with which the larvae scrape off deposits from the substrate. If this type of feeding predominates, the hairs with denticulate ends become more numerous and their development stronger, in extreme cases forming a long, inner brush. The median lobe is narrower, with dense spines in the form of a brush. The mandibles and maxillae bear rows of short, thick setae which not only remove the food from the lobe of the labrum but also scrape the substrate. The teeth of the mandibles are strongly developed but the maxillary palp is very small. The antennae are always rodlike and short, never reaching beyond the hairs of the labrum.

Longer antennae would interfere with feeding. The median and inner frontal hairs are relatively short, simple or slightly branched. The siphon is usually short, usually 4–5 times longer than its width at the base. This type of feeding is present in species of the subgenus Ochlerotatus and of the genus Culiseta, but their adaptation to this type of feeding varies and does not exclude planktonic feeding.

The filtration-planktonic type of feeding is connected with a stronger development of the head in width, so that it becomes transverse-oval. The complicated bending and rotatory movement of the labrum and maxillae during feeding inside the water and the collecting of planktonic food in the prebuccal cavity cause a diagonal direction of the musculature at a large angle with the longitudinal axis of the body. The lateral lobes of the labrum are widely separated and consist of two distinctly different bundles: an inner, broad and short bundle, directed anteriorly and inward, and an outer, longer bundle, directed obliquely, laterally and anteriorly. The hairs of the inner bundle do not have serrated ends. The median lobe is broad, half-round, not narrow as in larvae feeding on the substrate or on the surface. The teeth of the mandibles are thinner and the hairs denser and longer. The maxillae are markedly changed: they are conical, slightly tapering toward the base and the palps are strongly reduced. At the apex of the maxillae is a bundle of long, straight or slightly S-curved hairs, and their inner side is densely covered with short hairs. The maxillae are very mobile and take an active part together with the labrum in the movement of the food (terminal bundle) and its filtration (bundle of inner-lateral hairs). The antennae are usually long or very long and curved; the apical setae are often situated far from the subapical setae and all are long. The bundle forms a large fan with secondarily feathered branches. The frontal hairs are long and usually branched like a fan. Together with the bundle on the antennae they restrict the passage of food pushed by the lobes of the labrum. The siphon is usually thin and long, which increases the radius of the food-collecting area.

29 As a secondary adaptation, the predatory type of feeding develops in larvae adapted to feed on the substrate or plankton. In most predatory larvae the organ for catching food has become the labrum, which drives the food to the mouth in the phytophagous forms. In the predatory larvae of Toxorhynchites and Lutzia which occur in the USSR, the modified lateral lobes of the labrum catch the food. They are displaced markedly laterally, the median lobe is reduced, and the lateral parts of the clypeus are enlarged and project anteriorly. The hairs of the lobes are reduced in number (to 10 in Toxorhynchites and to 30–40 in Lutzia) and are transformed into hook-shaped setae. In Toxorhynchites they have coarse denticles at the end and the combs of chitinized denticles are much stronger in Lutzia than in larvae which feed on the substrate. The mandibles grasp the food already caught by the setae of the labrum and pass it into the pharynx. The hairs on them are partly reduced and the teeth more strongly developed. The hairs on the maxillae are transformed into shorter setae and they become smaller and rectangular. The antennae are short and the head of Toxorhynchites is rectangular with a large occipital foramen.

Thorax

The three segments of the thorax (prothorax, mesothorax and metathorax) are fused so completely that their borders can be determined only according to the arrangement of the hairs in 3 successive stripes. The thorax is dorsoventrally compressed, the ventral side more strongly than the dorsal. Its form varies from rounded-hexagonal to rounded-oval, according to the stage and age of the larvae. In the older stages the developing appendages of the thorax of the adult insect, the 5 pairs of imaginal discs, are visible through the transparent cuticle, especially on the ventral side. Three pairs (imaginal discs of the legs) are situated on the ventral side and extend to the median line toward the thoracic part of the ventral nerve cord. On each side near the dorsal side, are the imaginal discs of the wings and behind them those of the halteres. Dorsally, on both sides, at the anterior margin, are the imaginal discs of the respiratory horns of the pupa which begin to develop at the end of the 4th stage. Before the molt, they come into contact with the respiratory system of the larva, are filled with air, become dark and refract light. This is the first indication that the larva is ready for pupation.

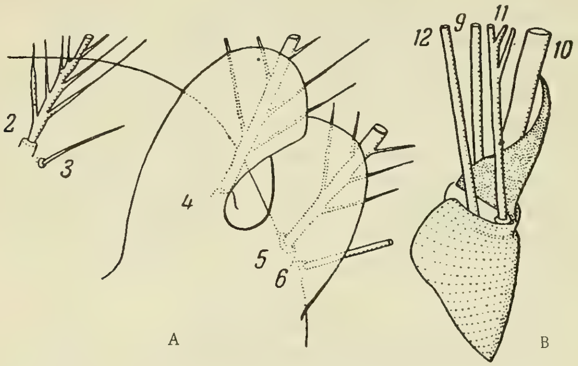

FIGURE 20. Thoracic hairs of larva of Anopheles (after Puri):

A – anterior margin of prothorax with notched shoulder organ; 2, 3 – middle and outer middle hair; 4–6 – lateral shoulder hairs. B – base of lateral hairs of prothorax: 9, 10 – ventral and dorsal hair of anterior pair; 11, 12 – dorsal and ventral hair of posterior pair.

30 All larvae of Anopheles have notched shoulder organs (Figure 20) which are situated at the sides of the anterior margin on the dorsal side of the thorax. These are hollow, transparent processes directed obliquely anteriorly and laterally and consist of 2 lobes on a broad base. From this point extends a retractor muscle attached to the ventral side. Extension of the organ takes place by pressure of the hemolymph. The shoulder organs, which are absent in all other larvae, are closely connected with the life of Anopheles larvae on the surface. They support the anterior end

of the larvae on the surface film and give the body stability if the head is rotated. These organs bear no relation to the developing prothoracic spiracles or to the respiratory system.

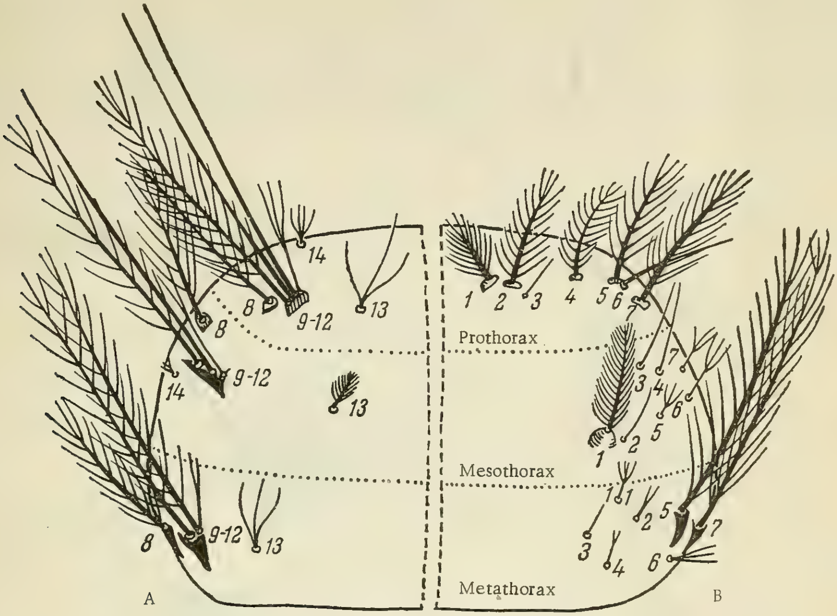

FIGURE 21. Thoracic hairs of a larva of Anopheles (after Puri):

A — ventral side; 8—12 — lateral hairs; 13, 14 — other hairs. B — dorsal side — prothorax: 1—3 — middle hairs (inner, middle and outer); 4—7 — shoulder hairs; mesothorax: 1 — inner middle hairs; metathorax: 1 — middle hair, often palmate.

Many thoracic hairs are of importance for the determination of Anopheles larvae (Figure 21): middle hairs (1, 2, 3) on the prothorax, lateral hairs of all three stripes (9—12) and hair 1 on the metathorax, which is often palmate. In the larvae of Culicinae, the group of middle hairs of the prothorax may be important for determination, and in Toxorhynchites the lateral hairs of all three stripes. However, these characters are not generally used since there are more convenient characters on the last segments of the abdomen.

Abdomen

The abdomen consists of 9 segments. The primitive number is 10, but the 8th and 9th segments became fused and form the complex 8th segment
31 (Figure 12). The last, 10th, segment thus becomes the secondary 9th segment. This fusion was caused by the formation of a stigmal plate as

the only functional organ which includes elements of the 8th segment (spiracles, anterior and lateral lobes or valves) and the 9th segment (posterior lobes or valves and the central plate with its processes). The posterior part of the 9th segment may be preserved in most species as an intermediate ring between the 8th and the last segments, and this rudiment disappears in some species of Uranotaenia (Figure 65) and others.

As the structure and development of the hairs of the first 7 segments is relatively similar, but the 2 last segments are distinctly different, their description is given below separately.

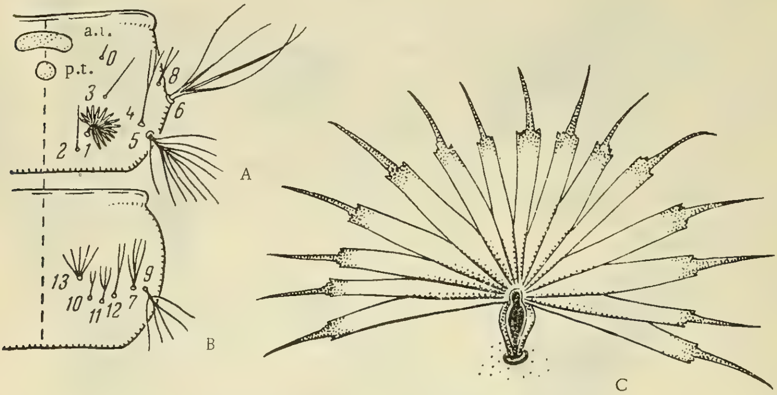

FIGURE 22. Sixth abdominal segment of an Anopheles larva (after Puri):

A – dorsal side. B – ventral side; p.t. and a.t. – posterior and anterior tergal plate; 1–13 – hairs (1 – palmate and 6 – lateral). C – palmate hair, high magnification.

Each of the first 7 segments bears 13 pairs of hairs in an irregular, zigzag row (Figure 22). The lateral (pleural) hairs are most strongly developed.

The palmate hairs on the dorsal side situated near the posterior margin of the Anopheles larvae are the most important for determination. They vary in form and development on the anterior segments. They are often rudimentary on the first segment – short, usually simple hairs. They are 3–4-branched only in A. lindesayi. They are very distinct in most species of Myzomyia. From the 2nd segment onward, they are more or less developed, from the 3rd to the 7th segment they are fully developed except in A. turkhudi, in which they are present only on the 4th and 5th segments.

The palmate hairs (Figure 22) consist of a short stem from which extend leaf-shaped, flattened branches parallel to the surface of the body. The form of the branches, their pigmentation, denticulation of the margins, etc. vary in the different species. These hairs, together with the shoulder organs and the stigmal plate, form the support of the larva in the suspended state from the surface film of the water. If the hairs are open they lie on the surface. If the larva is submerged, the leaves become folded
32 together and hold a bubble of air with the aid of which they break the surface film at the next rise to the surface.

The thorax with the shoulder organs and the stigmal plate are slightly raised above the surface of the 7th segment, and when the shoulder organs and stigmal plate touch the water surface, contact with the surface film of the palmate hairs near the thorax (first and second) and of the stigmal plate of the 7th and 8th segments is less likely than of the hairs on segments 3–6. The fact that palmate hairs are developed in all Anopheles larvae on the 4th and 6th segments, exceptionally on the 1st segment, and are absent on the 7th segment is due to the great variation of their development on segments 1–3 of the abdomen. They are therefore only fully developed on segments 4–6.

The lateral (pleural) hairs 6 (Figure 22) are also important for the determination of Anopheles larvae. Their important characters are their branching and relative development.

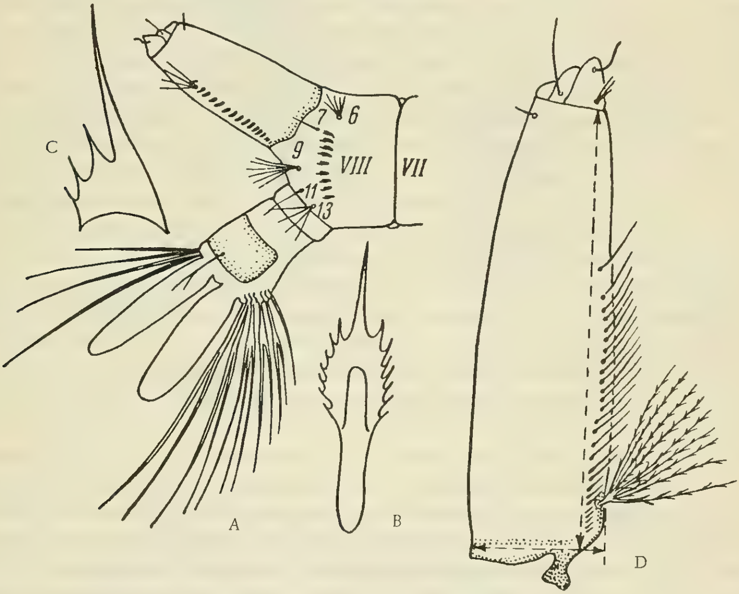

FIGURE 23. Posterior end of larvae of Culicinae (A), lateral:

VII, VIII – abdominal segments; 6–13 – hairs behind the comb (6, 13 – extreme upper and lower, 9 – median, 7, 11 – intermediate); B – scale of comb; C – tooth of pecten; D – siphon of larva of Culiseta, lateral. The arrows indicate the length of the siphon and its width at the base.

The hairs on the first 7 segments of the abdomen of larvae of Culicinae are not used in systematics, but the hairs and other formations on the last 2 segments are very important. The 8th segment of larvae of Culicini and Toxorhynchitini (Figure 23) bears a siphon in its posterior part. Before the siphon, near the posterior margin of the segment, is situated a comb which consists of a varying number of scales directed posteriorly. Their number varies from 5–7 to many tens. Each scale extends posteriorly and

often ends in a pointed spine. At its base are nearly always denticles on
33 both sides which decrease in size toward the base. These lateral denticles are sometimes only a little smaller than the main spine. In many larvae (Culiseta, Culex, some species of Aedes), the main spine is absent and the scale or only its free end has a row of denticles. The structure, number and position of the scales vary in the different species, but they are relatively constant in the same stage and species. If there are few scales of the comb, they may form a straight, curved or zigzag row; if there are many, they form a group. The structure of the marginal scales (upper, lower or posterior) often differs from that of the scales in the middle. The scales of Uranotaenia are situated on the posterior margin of a sclerite. In Toxorhynchites, there are instead of scales 1–3 strong spines which extend from the sides of the sclerite. The elongate scales of Orthopodomyia form 2 regular rows and are of complicated structure.

The comb is surrounded by 5 hairs posteriorly and dorsally. The dorsal and ventral and especially the middle hairs are the largest and branched like a fan; the two intermediate hairs are usually simple and shorter.

The siphon is of great importance in the systematics of the larvae. It is usually sclerotized to the base from the 3rd stage, and often darkly pigmented. Only its distal end is sclerotized in the 1st stage. The sclerotization extends to near the base in the 2nd stage. The siphon is rarely cylindrical but usually tapers toward the apex; it is rarely slightly widened at the apex (Culex territans). It is widest in the middle in some species. In cross section the apex is round or longitudinally oval. The base is usually darkly pigmented and slightly thickened anteriorly and on both sides, and there is a more or less deep incision posteriorly. There are 2 small processes, auricles, near the posterior margin, which are points of attachment of a muscle extending at a right angle to the base, the contraction of which curves the siphon posteriorly. The incision at the base facilitates this movement which is important in detaching the larva from the surface of the water. Auricles are not present in larvae of Stegomyia and Toxorhynchites and others.

One of the important characters for determination (Culex, some species of Aedes) is the siphonal index: the ratio between the length of the siphon and its width at the base. Measurement may give different values which are often not comparable in different species and with the data of various authors. The same method of measurement should therefore be used: 1) measurement of the siphon along the side; 2) measurement of the length without the valves of the stigmal plate, from the base of the auricle of the basal ring to the posterior margin of the apex at the base of the posterior valves of the stigmal plate; 3) width of the base should be measured along the line extending from its anterior margin through the base of the auricles to the point where it crosses the posterior margin of the base or its continuation if the incision of the posterior margin is distinct (Figure 23,D). In some cases (Culiseta), the ratio of the length of the siphon to the width of the apex is important.

The structure of the pecten and the position, development and number of setae on the siphon are of systematic importance.

34 Of the larvae of mosquitoes occurring in Russia, the pecten on the siphon is absent only in Orthopodomyia and Toxorhynchites; in all

others it is present as two symmetrical, longitudinal rows of denticles, spines or hairs at the sides of the posterior side of the siphon, beginning at the base. The denticles of the pecten are not of the same form; those near the base are small; farther away from the base the denticles become larger. Each denticle is like a pointed spine, usually with small, accessory denticles at the base; the distal denticles are the largest. The denticles are more or less regularly spaced or the distal denticles are more widely spaced. The pecten may extend beyond the middle of the siphon. Sometimes (Culiseta longiareolata) the pecten consists of a row of denticles which are widely separated along the entire siphon. In some larvae of the subgenus Culicella, the short pecten continues in a row of large spines, and in the subgenus Culiseta there are denticles only near the base, which then become longer and form long, thin hairs.

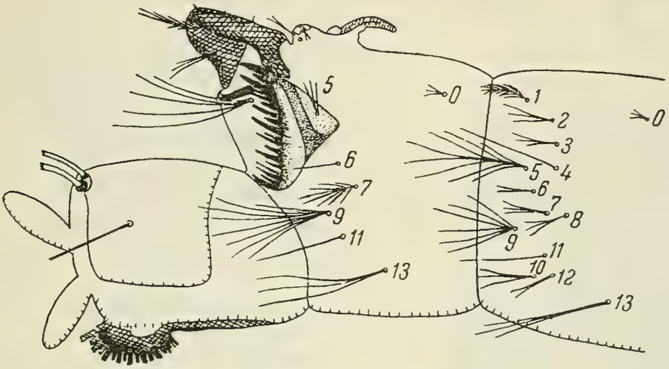

FIGURE 24. Posterior end of the abdomen of a larva of Anopheles, lateral (after Martini):

0–13 – hairs.

In most larvae, the siphon has only one pair of tufts of hairs in addition to a pair of short apical setae on the anterior side of the apex (Aedes, Culiseta). The tufts are situated near the middle (Aedes and others) or at the base of the siphon (Culiseta, Toxorhynchites). There are sometimes also 2–4 pairs of hairs on the anterior side of the siphon or at its apex (group rusticus of Aedes, A. cinereus). The siphon of larvae of Culex bears 4–8 or more pairs of tufts of hairs arranged symmetrically or displaced to the posterior surface. Of systematic importance are the number, position and the branching of the tufts on the siphon and also their length, the width of the siphon at the position of the hairs (some species of Culex and Aedes).

The hairs on the 8th segment of larvae of Anopheles resemble those of the Culicinae in number and position but are of no systematic importance. In 1st-stage Anopheles larvae, as in the Culicinae, there is a tuft at the sides of the 8th segment which consists of 5–6 oblong scales. This is no longer present in the 2nd stage.

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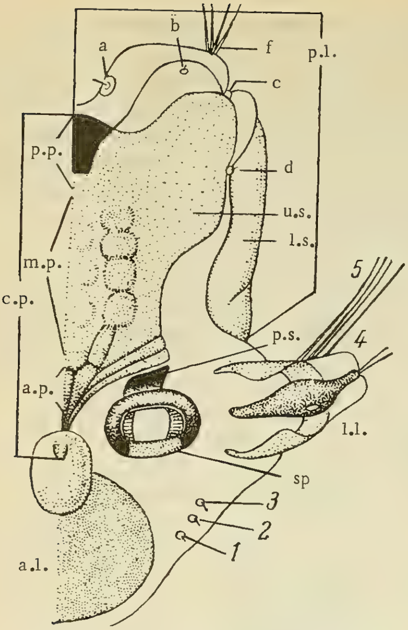

FIGURE 25. Stigmal plate of an Anopheles larva (diagrammatic):

p.l. — posterior lobe; l.l. — lateral lobe; a.l. — anterior lobe; c.p. — central plate; p.p. — posterior part; m.p. — median part; a.p. — anterior part; sp — spiracles; p.s. — processes of spiracles; u.s. — upper surface of posterior lobe; l.s. — lower surface (base) of posterior lobe; a, b, c, d, f, 1–5 — hairs of stigmal plate.

The absence of a siphon is characteristic for the larvae of Anopheles. The larvae have instead a special formation which supports the stigmal plate and is homologous to the siphon.

This formation consists of a dark, chitinized arc which surrounds the base of the posterior lobes posteriorly and has 2 lateral processes (Figure 24). The ends of the arc pass on both sides into the triangular plate, the posterior margin of which bears a row of large spines. The dorsal spines of this row correspond to the pecten of the siphon of Culicinae and the ventral row to the comb at the sides of the 8th segment of the abdomen. The development, structure and number of spines in the comb vary in different species and also in the different stages. The lateral chitinized plates are not developed in 1st-stage larvae. There is only a thin, chitinized arc and separate groups of scales corresponding to the pecten and comb.

The structure of the stigmal plate is often of great systematic importance and gives distinct characters for the determination of Anopheles larvae.

In the Anopheles larva (Figure 25), the spiracles are surrounded by 5 lobes: a single anterior lobe and a pair of lateral and a pair of posterior lobes. In the middle of the base of the anterior lobe there is an oval, transparent formation. Lateral to its base are 3 pairs of short hairs. Its upper surface may be dark (larvae of the 2nd stage of A. claviger, A. plumbeus, A. superpictus, and the last 3 stages of A. pulcherrimus) or the dark pigment is restricted to the base and the anterior part is lighter (A. maculipennis, A. hyrcanus).

On the dorsal surface of the lateral lobes is an elongate, dark, chitinized supporting plate with a sensory hair at the apex, its narrow base directed toward the spiracles.

The apical surfaces of the posterior lobes are fused with the central plate. The latter consists of 3 parts: an anterior part, tapering into the anterior process between the spiracles, the base of which may continue posteriorly to the anterior or the median part; a median part, and a broader posterior part. The sculpture of the central plate is different in the lateral and median parts. The last is the point of attachment of the dorsoventral muscles, which causes its reticulate structure, the position of the cells and their pigmentation. From the anterior process extend anteriorly

36 longitudinal dorsal muscles of the 8th segment. This is the appearance of the open stigmal plate if the larvae are on the surface.

After submersion, the anterior lobe turns posteriorly, covering the spiracles and the central plate to the median part. The spiracles are displaced anteriorly toward the base of the anterior lobe. The lateral lobes, the bases of which are connected with the spiracles but have no musculature, turn posteriorly and end at the ridge of the anterior margin. At the same time, the central plate, through the combined contraction of longitudinal muscles which extend from the anterior process and dorsoventral muscles extending from its median part, moves anteriorly and downward to deepen the cavity which opens dorsally in the posterior part. This cavity becomes filled with air during submersion. During the ascent this air pierces the surface film and the spiracles come into contact with the air.

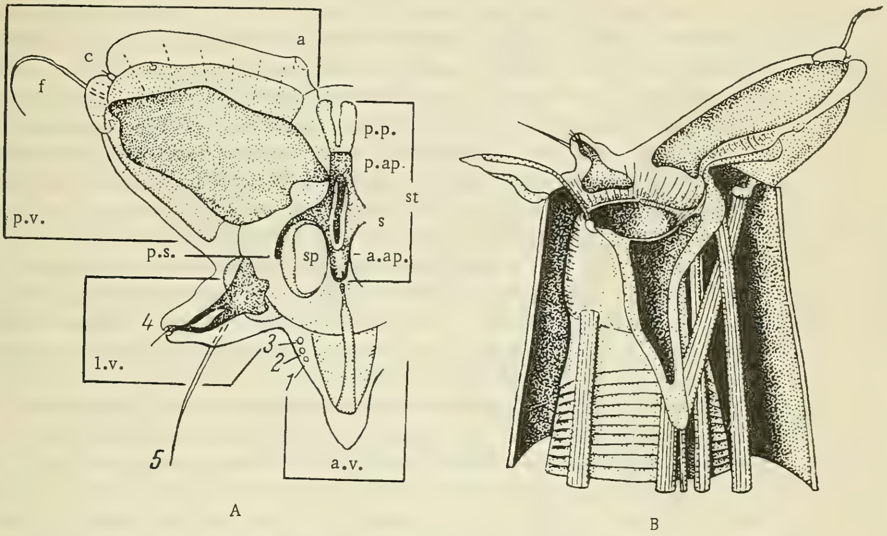

FIGURE 26. Structure of stigmal plate (diagrammatic):

A — stigmal plate of Culiciae larva: p.v. — posterior valve; l.v. — lateral valve; a.v. — anterior valve; st — "stirrup"; a.ap. — anterior appendage of "stirrup"; p.ap. — posterior appendage of "stirrup"; p.p. — posterior process; sp — spiracle; s — shoulder; p.s. — process of spiracle; a, c, f, 1–5 — hairs. B — sagittal section through end of siphon of a Culiseta larva with open stigmal plate.

In all 1st-stage larvae of Anopheles (Figure 14), the structure of the stigmal plate is the same and strongly reduced. In 2nd stage larvae, all its elements are already present but the specific characters are still indistinct. Their development becomes distinct only in the 3rd stage and in larvae of A. hyrcanus and A. maculipennis this takes place only in the 4th stage.

The presence of a siphon in Culicine larvae restricts the movement of the muscles to a direction parallel to the longitudinal axis of the siphon so that the chitinized elements of the stigmal plate become more differentiated than in Anopheles.

On the stigmal plate of Culicinae (Figure 26) the spiracles are surrounded by 5 valves homologous to the lobes of the plate in Anopheles: a single anterior lobe, a pair of lateral and pair of posterior lobes. Between the
37 posterior valves and the spiracles is a plate, the "stirrup" which is homologous to the central plate in Anopheles; is connected with most of the elements of the plate by processes and coordinates their movement.

The "stirrup" consists of a stem in the lumen of the siphon between the tracheal trunks. It is distinctly visible in lateral view. At the apex of the siphon, the stem widens and passes into the laterally compressed "stirrup" with a cavity which is open above. This cavity is formed by the development of the "stirrup" of the next larval stage which surrounds the old skin. The cavity of the "stirrup" is therefore absent in the 1st-stage larvae. The "stirrup" ends in a longitudinal, saddle-shaped widening and its ends form the anterior and posterior appendage. There is often an anterior process on the anterior appendage which is connected with the anterior valve. The posterior appendage continues into the posterior process the form of which is characteristic in many genera and species. From the sides of the saddle the processes extend to the spiracles and often surround their posterolateral margins. The spiracles are oval, rarely rounded, and are situated at the sides of the "stirrup." Their outer margins are situated in the plane of the plate and the inner margins follow the curve of the saddle.

During submersion, the "stirrup" is retracted ventrally because of the contraction of the retractor muscles which are attached to the stem. All parts of the stigmal plate are moved simultaneously and the spiracles face each other. All valves turn inward, come together above the spiracles and form a hollow, irregular pyramid. Air is kept in the cavity. The closing of the valves is usually not complete since the surface of the stigmal plate is not wettable, and water cannot enter the cavity to press the air out.

During the ascent, when the upward-directed hairs of the posterior and lateral valves touch the surface film, the retractors relax and their antagonists, a pair of levators of the "stirrup" which extend from it to the upper margin of the siphon, are contracted. The plate opens and the air in the cavity enters above the half-open valves and pierces the surface film, and contact is then established between the tracheal and the atmospheric air and the valves are situated on the surface.

Some characters of the tracheal system are of systematic importance. Two main tracheal trunks extend from the posterior spiracles to the prothorax. In most larvae, the main tracheal trunks, especially in the siphon and in the posterior segments, are oblong in cross section and appear ribbonlike in lateral view. In some larvae of Culex (especially in the subgenus Neoculex), Culicella and others they are thin and rounded in cross section. In larvae of Toxorhynchites and Orthopodomyia, the main tracheal trunks form a pair of widenings in the metathorax and partly in the first abdominal segment. In larvae of Mansonia, similar widenings are present on the branches of the main tracheal trunks. All these widenings have a hydrostatic function.

The last abdominal segment is narrower than the others. It forms an angle to the ventral side and bears a chitinized plate, the saddle, dorsally and laterally. The saddle, especially in young larvae, covers only the dorsal part of the segment or, usually, extends to the sides. It sometimes extends to the ventral side, surrounding the segment like a ring with a posterior

38 incision around the base of the fin. If this incision is absent, part of the anterior fascicles of the fin seem to be situated inside the ring which, like the saddle, has a supporting function. The posterior margin of the saddle bears denticles and spines of varying form which are especially strongly developed in Toxorhynchites.

The saddle always bears a moderately long or small lateral hair. On the dorsal side, in the middle of the posterior end of the last segment, behind the saddle, there are two pairs of hairs, the caudal hairs (Figure 23). The outer pair is situated on small sclerites and consists of longer and less branched hairs. The inner caudal hairs which are situated on the common sclerite are shorter, more strongly branched and often form asymmetrical fans. In Anopheles larvae (Figure 12), the hairs of the outer pair have curved, hooked ends which fix the larvae to objects floating on the water. Without them, the movements of the labrum would cause forward movement of the larvae.

Two pairs of gills surround the anus. Their development, form and color are often used in determination. In spite of their name, the function of the gills in the gas exchange is not greater than that of any other part of the integument. Their main function is osmoregulation. The size of the gills varies in different species from a third of the length of the body (Aedes pulchritaris, A. galloisi) to a small sphere. In some species the gills are longer when the concentration of salt in the water is low and they are smaller if it is higher. The gills may be sausage-shaped, with rounded or pointed ends, or lanceolate, leaf-shaped or spherical.

The gills are thin-walled, saclike processes with a thin cuticle, which is slightly permeable to water and substances dissolved in it. Its hypodermal cells are often strongly vacuolized and may contain pigmented inclusions. The cavity of the gills communicates with the body cavity and is filled with hemolymph, the movement of which is directed by a membrane which divides the cavity longitudinally but does not reach its end. The trachea passes through the membrane with a few branches toward the hypodermal cells. The gills of the larvae of Culicidae are therefore blood gills and not tracheal gills.

On the ventral side of the last segment is the fin or ventral brush, the main organ of movement which consists of a row of long, curved hairs situated in a zigzag line. They form a flat fan which is asymmetrically curved posteriorly. Each hair therefore usually branches asymmetrically posteriorly from the main stem. The fin is symmetrical only in larvae of Anopheles and Toxorhynchites and the hairs are two-branched.

During movement, the main pressure on the fin is directed laterally and the base of each hair is therefore strenghened by transverse lateral processes. Because of the zigzag arrangement of the hairs, the lateral processes are asymmetrical: if the base of the hair is situated on the right of the median line, the left lateral process is longer and the right shorter, and
39 vice versa. The ends of the processes are curved, fused, and form the common base of the fin. The hairs of the fin become shorter anteriorly and the lateral processes at the base weaker, but their ends are free. In some forms (many species of Aedes) there is a row of 2–10 much shorter, more weakly branched hairs, extending anteriorly from the base of the fin.

The fin is absent in the 1st-stage larvae of most species. In many species there is a reduction of the number and branches of the hairs of the fin and a reduction of the common base and the processes. This reduction of the fin is connected with the strong development of the gills (e.g. in Aedes pulchritarsis, A. galloisi, A. aegypti). The caudal hairs of the larvae curve down during movement into the space between the upper pair of gills and the hairs of the fin, which are curved dorsally, are situated between the lower pair of gills, and have a supporting function. The gills then become organs of movement.

Growth of larvae, changes of characters during growth, determination of the stage and age in the stage

The larvae molt 3 times, i.e. there are 4 stages. Their measurements increase by more than 8 times during development. All sclerotized formations (head, siphon, saddle, etc.) attain their maximum size during the molt and their minimum growth during the stage, while the other part of the body with soft cuticle, grows mainly during the stage and minimally during the molt.

The head, siphon and other hard parts are transparent and soft after the molt. They harden after a few hours and lose their transparency because of deposits of organic and inorganic substances. Their size increases slightly due to the stretching of the cuticle. Exceptions are the larvae of Anopheles (sometimes the siphon of Culicinae), in which there is an increase of the size of the "collar" (p. 20 and Figure 27) during the stage. The other part of the body covered with soft cuticle increases 90% during the stage and only 10% during the molt. There is always a distinct increase in the size of the larvae in the first 6–16 hours after the molt because of the stretching of the cuticle; the increase then becomes smaller and growth proceeds uniformly to the next molt only from the beginning of the 2nd day.

There are also morphological changes which are restricted to the molts, so that the larval stage or the age within the stage can be determined more or less accurately.

The newly molted larvae, in every stage, differ from older larvae not only in the pale pigmentation of the head, siphon and other sclerotized formations, but also in their relatively large head compared with the thorax. The hairs of the body, especially the lateral hairs, are not straight but have curved ends. Larvae approaching the molt or pupation are always dark, their head is always relatively small compared with the thorax, and the hairs, especially the lateral hairs, have straight ends. The hairs of the next stage, especially the long, lateral hairs of the segments, the hairs of the fin and caudal hairs which surround the segment under the old cuticle are visible through the cuticle. In larvae ready for pupation, the pupal respiratory horns, which are dark from the air filling them, are visible at the lateral angles of the prothorax.

With each stage, the branching of the hairs increases. This also takes place with the number of scales of the comb and with the teeth of the pecten, in which the number of accessory denticles at the base increases. If the scales of the comb are few (Aedes riparius, A. pulchritarsis), their number does not increase with the 2nd stage. The species can be determined at any stage by the quantitative changes of all characters, but these characters are unreliable and therefore of no use in determination.

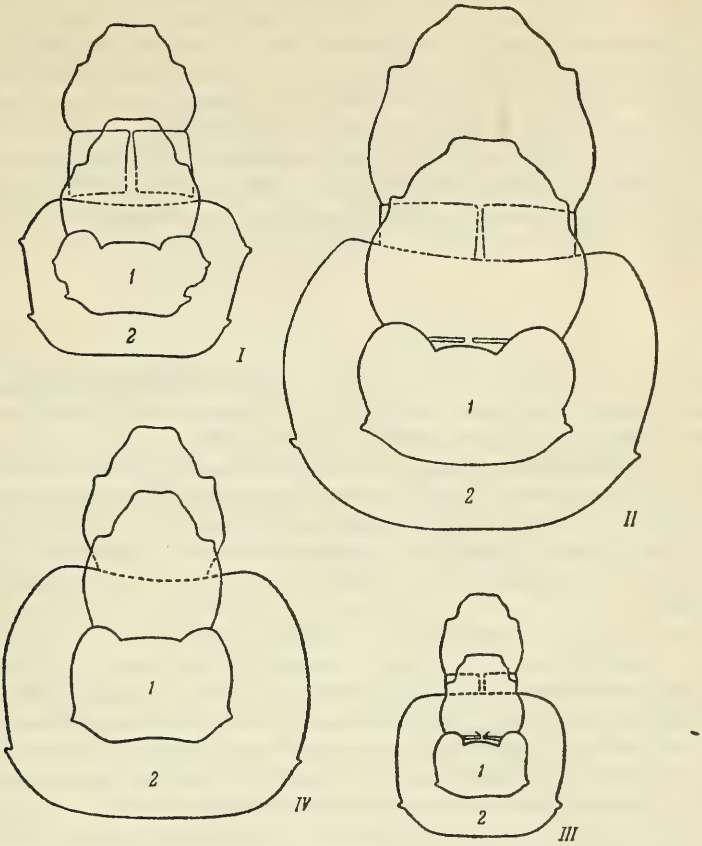

FIGURE 27. Outline of head and thorax of all stages of larvae of Anopheles maculipennis Mg. after the molt (1) and before the molt to the next stage (2): I, II, III and IV – larval stages (stages III and IV are shown 4 times smaller than stages I and II).

41 There are a few constant characters in some larval stages. Characteristic for all larvae of the 1st stage is the egg tooth on the frontoclypeus (Figure 14) and the absence of a fin. All hairs of the body are simple except in a few cases. Larvae of the 4th stage show the developing pupal horns which are in contact with the tracheal system before pupation and filled with air. Characteristic for all larvae of the 2nd and 3rd stage of the subfamily Culicinae is the vesicular thickening of the posterior or posterolateral margin of the spiracles which is distinct on the open plate and less so on the closed plate.

The following method of determining the larval stage seems most convenient. The larvae are placed in a white enamel bowl and around it four small dishes. The largest larvae with the widest head are placed in one dish. The smallest larvae with the narrowest head are placed in another dish. The larvae with the widest and narrowest heads belong to the 4th and 1st stage. Of the other larvae, smaller specimens of the 4th stage and larger specimens with the same head are collected; the same is done for the 1st-stage larvae. The other larvae are divided into two groups, irrespective of size. One group with a head wider than in the 1st stage and the other with a head narrower than in the 4th stage is placed in the middle dishes. Mistakes made will be recognized since larvae placed in the wrong dish will differ from the others in the width of the head. This method makes it possible to determine the larval stage with certainty.

PUPA

Larvae of the 4th stage pass into the pupal stage; processes of histolysis and histogenesis take place and the fully formed, adult mosquito develops in the pupa. The pupae do not feed and are connected with the outer environment only by the gas exchange. They are usually suspended from the surface film and their horns are in contact with the atmospheric air. They are capable of rapid movement and descend to the bottom if disturbed. If they are not disturbed, they may remain on the surface for a long time. The duration of the pupal stage usually lasts only 2–2.5 days. The males hatch first.

42 The pupae have the form of a comma in lateral view; they are irregularly oval seen from above. The body consists of two parts: a large cephalothorax and a narrower, dorsoventrally flattened abdomen. The dorsal and anterior parts of the cephalothorax are formed by the thorax, the ventral part by the head. The developing appendages of head and thorax are situated in the ventral and posterior parts of the cephalothorax. The pigmented eyes are visible through the transparent cuticle. Above them, at the sides of the dorsum are the pupal horns which are wider apically, wider in the Anophelinae than in the Culicinae. If the pupae are at the surface, they lie in the plane of the surface. From the base of the horns extend the tracheae, which connect them with the prothoracic spiracles of the developing insect. Direct contact of the pupal horns with the tracheae takes place in 4th-stage larvae a few hours before pupation and the horns become filled with air. In pupae of Mansonia, in connection with their method of breathing, the horns are pointed and serrated at the end.

The abdomen of the pupae consists of 9 segments, of which the last segment, morphologically the 8th and 10th, consists of the fused 8th and 9th segments. On the posterior margin of the dorsal side of the 8th segment are two paddles, which are the organs of movement of the pupae. They are irregularly oval plates with a narrow base. The plates are attached by a longitudinal median ridge which does not reach the free margin which often bears a row of denticles or small spines. At the end of the ridge is a hair slightly inward from its base and a shorter hair. The paired primordia of the paddles of the pupa are situated in the larva in the posterior part of the siphon (Culicinae) or between the formations which support the stigmal plate which are homologous to the siphon in the Anophelinae.

The last segment is a narrow ring; from its ventral part extends a pair of terminal lobes between the bases of the paddles. These are the genital appendages, which are short in females and much longer in males. The sex of the pupa can be determined by their size.

On the dorsal side of the first segment is a pair of palmate hairs resembling those on the dorsal side of the 1st and 7th segments of Anopheles larvae and which have the same function. They are absent in Mansonia. The relative development and branching of the hairs of segments 3–8 are important for the determination of pupae. Segments 3–7 have 8 pairs of hairs on the dorsal side, segment 8,3 pairs of hairs.

Since the determination of species is usually made with larvae and adult mosquitoes, we are not describing the generic and specific differences of the pupae.

GEOGRAPHICAL DISTRIBUTION

Paleontological data on the family Culicidae are so few and fragmentary that they do not help to determine their recent geographical distribution.
43 Their geological age is not exactly known, but primitive characters of the Culicidae, both of larvae and adults, suggest a great antiquity. Bloodsucking mosquitoes appeared hardly later than the Jurassic (Edwards, 1923). The essential absence of eurythermal vertebrates at that time did not exclude the possible evolution of the group. There are even now some species which prefer to feed on reptiles and amphibians, e.g. Culex territans.

Reliable paleontological data on the Culicidae begin with the Eocene (particularly in North America), from which 2 species of the genus Culex have been described. Mosquitoes from the Oligocene are more numerous but bloodsucking forms have not been found in the Lower Oligocene amber in the Baltic area. The amber contains only species of related families which are not bloodsucking, mainly Dixidae and Chaoboridae. About ten species of mosquitoes of the recent genera Culex, Mansonia, Aedes and Anopheles are known from the Oligocene.

The recent fauna of bloodsucking mosquitoes (Culicidae) is not very large. There are about 2,500 species of 30 genera (Stone, Knight and Starcke, 1959). This figure does not include all the forms, but in view of the intensive study throughout the world in recent years, it will probably not increase much.

The mosquitoes are mainly a tropical group. Not only are there many more genera and species in the tropics but there is also a marked, ancient differentiation of the fauna which is reflected in the presence of endemic groups in each zoogeographical region in the tropics.

The fauna of mosquitoes is especially well defined in the Neotropical region, which contains characteristic endemic genera and subgenera, some of them with numerous species. These are mainly genera of the tribe Sabethini, which is predominant in the Neotropical region: Trichoprosopon (32 species), Phoniomyia (22 species), Sabethes (21 species), Limatus (8 species). The large genus Wyeomyia (about 90 species) of this tribe is restricted mainly to this region. Very few species of this genus enter the southern parts of the Nearctic region. Endemic to the Neotropical region are also some groups of the subfamily Anophelinae, e.g. the genus Chagasia and the subgenera Stethomyia, Kerteszia, and Lophopodomyia of the genus Anopheles. Not strictly endemic but characteristic for the Neotropical region are the genera Psorophora and Deinocerites and the subgenera Melanoconion (Culex) and Nyssorhynchus (Anopheles).

The fauna of mosquitoes of the Ethiopian and Oriental regions is also very rich in species but their differentiation is not as marked as in the Neotropical region. There is only one endemic genus, Eretmapodites, with 23 species in the Ethiopian region and the subgenera Myzomyia (Anopheles), Stegomyia and Aedimorphus (Aedes) and the genera Ficalbia, Mansonia and Uranotaenia.

Endemic in the Oriental region, in addition to some small groups, are the
44 genera Topomyia (21 species) Heizmannia (18 species) and especially Armigeres (41 species). One species of the last two genera occurs in the Palaearctic region. The subgenus Myzomyia, the genus Toxorhynchites and the subgenera Aedes, Finlaya and Stegomyia of the genus Aedes are well represented in the Oriental region.

The Australian fauna of Culicidae is small and there are few endemic forms. The genus Opifex with one species and some of the small and little differentiated subgenera of the genus Aedes may be considered as endemic.

In the Holarctic region (Nearctic and Palaearctic), the fauna of mosquitoes is also small compared with that in the tropics (in numbers of species). It is easier to characterize them by the absence of some groups than by their presence. Particularly characteristic for this region are the large number of species of the subgenus Ochlerotatus (genus Aedes) and the distinct role of the genera Culiseta and Anopheles. The most important negative characteristics are the small numbers of the subgenus Myzomyia (absence in the Nearctic), the small role of the genera Toxorhynchites, Tripteroides, Uranotaenia and Armigeres and of the subgenera Aedes and Aedimorphus, the relatively few species of the genus Culex and the absence of many of the tropical groups of mosquitoes.

Characteristic for the Holarctic is the wide distribution of many species, which often has a zonal character.

The northern boreal region includes the Canadian region and the tundra and forest areas of the Palaearctic (except for the broadleaved forests of the Far East). The species of the subgenus Ochlerotatus (genus Aedes) predominate in number and "biomass" here. Also present are some species of Anopheles and Culiseta, several subgenera of Aedes and a few species of Culex, but the genera Toxorhynchites, Tripteroides, Uranotaenia, Orthopodomyia and Armigeres and the subgenera Myzomyia and Stegomyia are absent and species of the genus Culex are few.

The Arctic subregion is characterized by a few species of the genera Aedes (subgenus Ochlerotatus) and Culiseta and the absence of all other groups.

The Mediterranean subregion, which includes the Mediterranean, Asia Minor and adjacent countries, the southern shore of the Crimea, Transcaucasia and a large part of Middle Asia, is characterized by the presence of the group Myzomyia, which plays an important role in the southern parts, and the genera Uranotaenia, Orthopodomyia and Culex, the last of which in number of species surpasses Ochlerotatus, which is represented only by very few species.

The Palaearchearctic subregion (Manchuria) includes the eastern and northeastern parts of China, Korea, Japan, the Maritime Territory and the southern Amur area. Characteristic for these areas are Toxorhynchites, numerous species of Finlaya and Stegomyia and Oriental species of Culex.

45 The mosquitoes of Mongolia and the mountains and highland deserts of Central Asia are little known. The number of species of Culicidae is possibly much greater than is known at present.

The fauna of mosquitoes in the southern parts of the Nearctic (Sonorian region) is very characteristic and contains neotropical elements.

The absence of endemic subgenera and genera in the Holarctic and part of the Palaearctic suggests that the fauna is very young. It is debatable whether under the same conditions the evolution of mosquitoes may be slightly retarded compared with organisms exposed to more varied environmental factors.

The development of the recent fauna of Culicidae in the Palaearctic did not take place simultaneously in the different parts nor in one center. A study of the world fauna of Culicidae suggests the following scheme of its formation. Southern elements spread to the north in the preglacial period. Ethiopian elements spread into the western part of the Palaearctic and Oriental elements into the eastern part.

The Mediterranean fauna of mosquitoes developed under the specific, and apparently continuing, influence of the Ethiopian fauna. This is also reflected in the specific composition of mosquitoes in the USSR, where numerous Mediterranean species (23) are represented. Some of them are also distributed in the Ethiopian region. Mediterranean species are well represented in the southern Ukraine, the Caucasus and in Middle Asia, some of them spreading far to the north. Anopheles algeriensis occurs in Estonia (Remm, 1957), and Aedes geniculatus in Chuvash and Tatary (Volkova, 1956). The spread of some Ethiopian species far to the north and northeast, e.g. Culex theileri, to the Kharkov Region and Culiseta longiareolata to the southern regions of West Siberia, is remarkable.

A similar, but less distinct phenomenon appears in the eastern Palaearctic, in the Palaearchearctic subregion (Manchuria), where the fauna is mainly Oriental. In the extreme Southeast of the USSR, 18 species of mosquitoes have been found which are characteristic for the Manchurian subregion (including Oriental species). The distribution of this group is mainly restricted to the Maritime Territory and the southern Khabarovsk Territory, some of them only in the far south of the Maritime Territory. These include Toxorhynchites christophi, Aedes nipponicus, A. flavopictus, A. nobukonis, A. aureus and Culex hayashii. The occurrence of a large group of Oriental species of the genus Culex, including C. vorax, C. fuscanus, C. tritaeniorhynchus, C. bitaeniorhynchus, C. sinensis, C. whitmorei and C. jacksoni is noteworthy.

The fauna of the boreal and arctic zones, with its numerous species of the subgenus Ochlerotatus, is not connected with the tropical fauna of 46 the eastern hemisphere. The boreal and arctic fauna of mosquitoes of the Palaearctic is closely connected with the Nearctic, where groups characteristic for the boreal zone are numerous. For example, 23 species of Culicidae occur in both the Palaearctic and Nearctic regions. All of them occur in the USSR. The origin of the boreal and arctic fauna of mosquitoes of the USSR is connected with the Nearctic.

It is not known how the boreal mosquitoes entered the Palaearctic from the Nearctic. The immigration apparently took place from the West and the East. Until the separation of America from Europe the western route was probably used by some forms of the more southern latitudes of the western Palaearctic. An example is the group of species of the genus Orthopodomyia, which are related to O. pulchripalpis. This group is represented in the Palaearctic only by O. pulchripalpis, which is distributed from the Mediterranean to southern England and Azerbaidzhan in the east. Two species related to this group are common in the eastern states of North America. The well defined group rusticus of the subgenus Ochlerotatus, which is distributed over a large part of the Mediterranean and the Volga area, West Siberia and the Baikal area, also has a representative in North America, A. trichurus Dyar.

However, there must also have been an eastern route for the exchange of fauna between the Nearctic and Palaearctic. This is supported by the common distribution of some species in both regions in the western part of the Nearctic and the close resemblance of the specific composition of mosquitoes in Northeast Asia and Northwest America. Of the 27 species of mosquitoes found in Alaska (Gjullin, Sailer, Stone and Travis, 1961), 17 also occur in Siberia.

The geological period associated with the entry into the Palaearctic of some species is difficult to determine. It is only certain that the main contingent of mosquitoes entered the boreal zone of the Palaearctic in the Upper Tertiary, at any rate before the Pleistocene. This is proved by the presence in the mountains of the southern Palaearctic (Pyrenees, Caucasus, Tien Shan) of a number of Culicidae which belong to forest areas, e.g. Aedes pullatus and Culiseta alaskaensis. The spread of numerous southern elements, Ethiopian and Oriental, into the boreal fauna was probably more extensive than it is at present. The pressure of the southern elements in the USSR mentioned above proves this.

When the geographical distribution of mosquitoes in the Palaearctic is studied, it should be remembered that most of the species of Culicidae are widely distributed and endemism in the various geographical regions is relatively weakly developed. The cosmopolitan distribution of Culex pipiens is often quoted as an example of a wide distribution. But this is a typical synanthropic species and its wide distribution is probably connected with man. A more convincing example would be the "feral" Aedes vexans, which is distributed in Europe, Asia, Australia, Oceania, Africa and North America.

We know little about the Palaearctic species of mosquitoes with a small distribution. Possible examples are Culiseta setivalva (Crimea, Western Transcaucasia, Bulgaria, Anatolia) and Aedes alektorovi

(Maritime Territory, southern Amur area), but their apparently narrow dis-
47 tribution may be due to insufficient collections.

It is characteristic that in a well studied area like the Caucasus, in which many endemic species of insects are found, there is not a single endemic species of mosquito. Endemism determined by mountains is usually not characteristic for mosquitoes. There is not a single species which occurs only in mountains in the USSR, but in other bloodsucking Diptera, Simuliidae, Ceratopogonidae and Tabanidae, such species are numerous. Aedes pullatus, the only species which is usually considered as a mountain form, also occurs in the plains in the northern parts of its range.

The fauna of mosquitoes of the USSR at present (1966) consists of 85 species belonging to 8 genera, half of them species of Aedes. In the thirty years since the publication of the previous edition of this volume, the list of species has increased by 17 due to the description of 5 new species and the discovery of 17 species hitherto not known to occur in the USSR. On the other hand, 4 species have been omitted as their status is doubtful (Aedes duplex Mart., Culiseta silvestris Shing.) or they have been considered as subgenera (Aedes esoensis, A. rossicus). Aedes lepidonotus has been excluded from the list of mosquitoes of the USSR as its occurrence is doubtful. This list is not definitive. It will probably grow but not very much.

IMPORTANCE OF MOSQUITOES FOR MAN

MOSQUITOES AS BLOODSUCKING INSECTS*

Mosquitoes are an important element of bloodsucking flies which are a scourge in the taiga, tundra and other landscapes. Their economic importance is determined by the fact that they attack man and animals. The injury is done by the females, which feed on plant juices but also on the blood of man, mammals, birds and other animals.

Mosquitoes are temporary parasites since their contact with the host is very brief, just long enough to suck blood. The bite is little noticed or not felt at all due to their thin mouth parts (the proboscis of Anopheles is only about 0.055 mm thick). At the beginning of bloodsucking, saliva is injected through the hypopharynx, the secretion of the salivary glands in
48 the thorax. The amount of saliva is very small, 1–3 μg in Aedes aegypti, average 4.7 μg (Devine, Venard and Myser, 1956), but the effect of the bite is often very marked. It depends on the species of mosquito, the sensitivity of the subject and the number of bites (single or multiple bites).

People react differently to mosquito bites. The reaction varies from total insensitivity to high sensitivity, depending on the constitution of the subject and on its allergic state (anaphylaxis). In many people of low sensitivity the bites of Anopheles cause only slight reddening of the skin and a small papule at the site of the bite. After the bite of some species of Aedes, a swelling appears in 10–20 minutes which may be 12 mm wide.

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* Written by E.N.Pavlovskii.

The subjective symptoms are itching and a burning sensation. Birds react severely to bites of Aedes but show little reaction to bites of Culex. The bite may cause local inflammation. This is usually secondary, because the mosquito had fed on infected material earlier and had then injected the infection into the host. Scratching may also result in secondary infections.

In mass attacks, the general reaction of the skin and sensitivity increase correspondingly. The papules may fuse and the skin swells, for a day. If there is only a single bite, the pain is slight, but if there is a massive attack it may be intolerable. During the mass flight of mosquitoes (especially of Aedes), field work is impossible, at least during the hours the insects are active. This hinders work in the forest, building of dams, bridges, roads, etc.

Domestic animals also suffer from mosquitoes. Cattle cannot work or pasture. Fattening and milk yield decrease. All this is due not to loss of blood but to the toxic effect of the saliva and to side effects of the bites. The toxic properties of the saliva are the primary cause of the skin reaction and general reactions (Pavlovskii, Shtein and Perfil'ev, 1928; Hecht, 1929).

MOSQUITOES AS VECTORS OF DISEASE

Mosquitoes are important vectors of human disease. Filariasis, yellow fever and dengue are common in the tropics but malaria, mosquito-borne encephalitis, etc. also occur in the temperate zone. Control of the vectors is important in prophylaxis, and its success depends upon an intimate knowledge of their specific composition and biology.

There has been little study of the transmission of disease to domestic
49 animals, and yet this is certainly important. Mosquitoes also transmit disease to wild animals, but this has been little studied.

The causative agents which mosquitoes transmit are plasmodia, filariae, bacteria and viruses.

Mosquitoes and plasmodia of malaria

Species of Anopheles transmit all four species of plasmodia, which cause malaria in man: Plasmodium vivax, P. ovale, P. malariae and P. falciparum. People with gametocytes in the blood are the source of infection of mosquitoes. Fertilization of the plasmodia and part of their life cycle and reproduction, sporogony, take place in the mosquito and end in the appearance of sporozoites in the salivary glands. Infection takes place during the bite by the saliva which contains sporozoites.

Most species of Anopheles are able under experimental conditions to transmit plasmodia from man to man to a greater or lesser extent, but the epidemiological importance of the different species is very irregular in nature, depending on the susceptibility to the infection by the various species of plasmodia, length of life of the mosquito, frequency of attack on man, duration of seasonal activity, etc. (Beklemishev, 1941).

Only a few species are effective (actual or potential) vectors of malaria:*

Region	Species of Anopheles
Europe (except the Mediterranean), Siberia	A.maculipennis Mg.
Southern Europe, Transcaucasia	A.maculipennis Mg.
	A.superpictus Gr.
Middle Asia	A.maculipennis sacharovi Favre
	A.superpictus Gr.
	A.pulcherrimus Theob.
East Asia	A.hyrcanus Pall. (s.l.)
	A.pattoni Christ.
Southeast Asia	A.minimus Theob.
	A.maculatus Theob.
	A.sundaicus Rod.
	A.jeyporiensis James
	A.leucosphyrus Dön.
	A.letifer Sand.
	A.umbrosus Theob.
	A.barbirostris V.d.Wulp
	A.aconitus Dön.
	A.hyrcanus Pall. (s.l.)
Australia, New Guinea	A.punctulatus Dön.
	A.farauti Lav.
India	A.stephensi List.
	A.culicifacies Giles
	A.minimus Theob.
	A.sundaicus Rod.
	A.fluviatilis James
	A.philippinensis Ludl.
50 Southwest Asia	A.maculipennis Mg. (s.l.)
	A.superpictus Gr.
	A.stephensi List.
North Africa	A.maculipennis Mg. (s.l.)
	A.sergenti Theob.
	A.multicolor Camb.
	A.pharoensis Theob.
Africa south of the Sahara	A.gambiae Giles
	A.funestus Giles
	A.nili Theob.
	A.pharoensis Theob.
	A.rufipes Gough
South America	A.darlingi Root
	A.albimanus Wied.
	A.aquasalis Curry
	A.pseudopunctipennis Theob.
	A.albitarsis Arr.
Central America	A.albimanus Wied.
	A.pseudopunctipennis Theob.
	A.aquasalis Curry
	A.quadrimaculatus Say
North America	A.freeborni Aitk.

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* From different sources: Russell et al., 1946; Horsfall, 1955; Foote and Cook, 1959, and others. These data were obtained when malaria was widespread. Malaria has now been eradicated or become rare in many countries.

In the past, when malaria was prevalent, 2 of the 9 species of Anopheles which occur in the USSR were considered as important vectors: A. maculipennis, in nearly the entire area in which malaria was present, and A. superpictus, in Middle Asia and Eastern Transcaucasia. Three or four species, A. pulcherrimus, A. hyrcanus, A. claviger and, possibly, A. plumbeus, were considered as vectors of local or minor importance. A. algeriensis, A. marteri and A. lindesayi do not transmit malaria. In India, only 7 of the 42 species of Anopheles which occur there are serious vectors of malaria (Roy, 1946). In Malaya, 6 of the 47 local species of Anopheles are considered as serious vectors (Sandosham, 1959). In Brazil, 4 of the 50 local species of Anopheles are the main vectors and 5 are minor vectors (Ferreira, 1964).

The duration of the gonotrophic cycle of Anopheles is usually shorter than that of the sporogony of plasmodium at the same temperature and sporozoites may appear only in females after 3–4 gonotrophic cycles (Beklemishev, 1944). The life of a mosquito is short and most die before the sporogony is completed (Detinova, 1962).

In localities in which control includes residual insecticides, the population of mosquitoes becomes reduced and their life shortened. The females do not live to the infective stage, i.e. to the time when there are sporozoites in the salivary glands. This causes a reduced circulation of the plasmodia. The use of residual insecticides alone or combined with other methods has eradicated malaria in many parts of the world including the Soviet Union.

Malaria has been eradicated in some countries but there are areas where, in spite of control, transmission of plasmodia continues. These are designated problematic regions (Committee of Experts on Malaria, 1965).
51 The difficulties may be connected with the "entomological factor:" resistance of mosquitoes to insecticides, changes in the behavior of the vectors, the appearance of new species or subspecies in a locality, the replacement of endophilic species of Anopheles by exophilic species, etc. These problems can be overcome only by a more detailed study of the specific ecology of the species of Anopheles.

Control carried out for a long time has resulted not only in a lowering of their numbers but also in their eradication in many regions. An illustration has been given by Kalmykov (1965) which shows the gradual reduction of the distribution of A. maculipennis sacharovi and A. pulcherrimus in Tadzhikistan.

Mosquitoes also transmit plasmodia of animals. An exception is apparently Hepatocystis kochi, a parasite of African monkeys which is transmitted by Ceratopogonidae like probably also other species of this genus, but the genus Hepatocystis should be removed from the family of Plasmodiidae and transferred to the family Haemoproteidae. The vectors of the plasmodia of monkeys are species of Anopheles. Thus, Plasmodium cynomolgi bastianelli (which may also parasitize man) developed under experimental conditions to the stage of sporozoites in Anopheles hyrcanus, A. kochi Dönitz, A. maculatus, A. philippinensis Ludlow, and A. sundaicus (Warren et al., 1963). The only carriers of plasmodia in Malaya are A. balabacensis Baisas, A. leucosphyrus and A. hackeri Edwards. P. brasilianum was successfully transmitted from Ateles geoffroyi to other monkeys of the same species and also to human volunteers by A. freeborni (Contacos et al., 1963).

Species of Anopheles are also the vectors of plasmodia of rodents. Plasmodium berghei is the most thoroughly studied and most often used in experiments with parasites of malaria. This parasite was transmitted experimentally from one rodent to another by Anopheles (A. stephensi, A. quadrimaculatus; see Yoeli, 1965) and also by Aedes aegypti (see Raffaele, 1965). Under natural conditions A. dureni Edwards (Vincke, 1964) transmitted P. berghei in the Congo (Kinshasa).

Species of Culex are the vectors of plasmodia of birds; Plasmodium gallinaceum, P. lophurae, P. fallax and others are transmitted by species of Aedes. Some plasmodia of birds may possibly also develop in Anopheles, for example P. gallinaceum in A. quadrimaculatus. Details have been given by Huff (1965).

Plasmodia of animals are sometimes transmitted by mosquitoes which do not bite man, for example A. hackeri, a vector of some plasmodia of monkeys in Malaya (Wharton et al., 1964), but A. letifer is a vector of human plasmodia and of P. traguli, which parasitizes Tragulus javanicus (Wharton et al., 1963) in that area. Under these conditions, the evaluation of studies on the natural infection of mosquitoes with plasmodia is obviously difficult.

There are also provisional data on the possible role of mosquitoes as vectors of plasmodia in reptiles. Oocysts were found in a few species
52 (Culex territans, etc.) which feed on lizards infected with P. floridense.

Mosquitoes and filariae

Mosquitoes are the intermediate hosts of some nematodes of the suborder Filariata (referred to below as filariae). The mosquitoes ingest the microfilariae with the blood of the vertebrate. The microfilariae develop in the thoracic muscles, in the body cavity and fat body or in the Malpighian tubes. Infective larvae migrate to the proboscis of the mosquito and enter the skin during the bite. Filariae do not multiply in the vector. Only a few larvae ingested by the mosquito are infective.

As the result of the long, related evolution of the parasite and its intermediate host, special adaptations developed, e.g. the periodicity of the microfilariae in the peripheral blood of the vertebrate which corresponds to the diurnal activity of the mosquito. Thus, the microfilariae of Wuchereria bancrofti appear in the peripheral blood of man at night, which corresponds to the nocturnal activity of most mosquitoes. An exception is the aperiodic variety of this parasite in Polynesia which appears in the blood during the day, and its intermediate host is Aedes polynesiensis Mag. (Mattingly, 1962).

There are over 30 species of filariae, parasites of man and animals, transmitted by mosquitoes. Further details are given by Lavoipierre (1958), Hawking and Worms (1961) and Nelson (1964). However, the life cycle of Filiarata is known only in 10% of the species.

Of the filariae parasitizing man, *Wuchereria bancrofti* and *Brugia malayi* are transmitted by mosquitoes (for their vectors, see Infections Caused by *Wuchereria* and *Brugia*, 1963; Edeson and Wilson, 1964). The larvae of these species develop in the thoracic muscles of the mosquito.

Wuchereria bancrofti infects millions of people in the tropics and subtropics in both hemispheres. The list of mosquitoes in which the larvae develop to the infective stage includes numerous species, mainly of *Culex* and *Anopheles*, but in many species of mosquitoes *W. bancrofti* does not develop or its development is retarded or ceases at some stage. Some species of different genera are "good" vectors while the microfilariae do not develop in related species of the same genera. There may also be distinct differences between the subspecies of the same species. Thus, *Culex pipiens fatigans* is a "classic" carrier of *W. bancrofti* although the larvae of this nematode do not develop in *Culex pipiens pipiens*. There may also be differences in susceptibility to infection
53 between different populations of the same species of mosquitoes. Individual differences have also been observed in infection not only with filariae but also with other parasites, e.g. plasmodia, viruses.

The role of mosquitoes as vectors of filariae depends on many factors. Under natural conditions, few species of mosquitoes transmit filariasis to man. In most countries in which *W. bancrofti* is endemic one of the main vectors is the circumtropical, synanthropic *C. pipiens fatigans*. A large role in the distribution of the filariae is apparently played by *Anopheles gambiae* (Africa), *A. hyrcanus* and *Aedes togoi* (East Asia), *A. minimus* and *A. nigerrimus* Giles (Southeast Asia), *A. farauti* and *A. bancrofti* Giles (New Guinea and the Solomon Islands) and other species. *W. bancrofti* is known at present only as a specific parasite of man, and synanthropic species of mosquitoes or at any rate mosquitoes which feed mainly on man are therefore the main vectors.

Brugia malayi is widely distributed in Southeast Asia, its main vectors are *Aedes togoi*, *Anopheles hyrcanus*, *A. nigerrimus* and species of the genus *Mansonia*. Man may be infected by mosquitoes ingesting microfilariae from animals since the filariae parasitize not only man but also domestic and wild animals (cats, monkeys, etc.). Species of *Mansonia* transmit the filariae among animals.

Cases of wuchereriasis have been introduced in the USSR, but the local origin of cases cannot be excluded since species known as vectors of filariae occur in the USSR and the temperatures in Transcaucasia and Middle Asia permit the development of larvae of filariae in mosquitoes. The discovery of a focus of wuchereriasis in the mountains of East Anatolia (Yucel and Deschiens, 1960) is of interest.

Mosquitoes are also apparently the intermediate hosts of other species of *Brugia* which parasitize animals. A detailed study was made of the development of *Brugia ceylonensis*, a parasite of dogs, in *Aedes aegypti*, in which the larvae developed in the thoracic muscles (Jayewardene, 1963).

The role of mosquitoes as intermediate hosts of filariae of other genera parasitic in animals has also been studied. The transmission of *Dirofilaria* of dogs (*Dirofilaria immitis* and *D. repens*) has been investigated. The larvae develop in the Malpighian tubes of *Anopheles* maculipennis, A. claviger, A. hyrcanus, Aedes aegypti, A. albopictus, A. vexans and others. Dirofilariasis of dogs is widely distributed in the southern USSR (Ukraine, Caucasus, Middle Asia). Dirofilaria of monkeys is also transmitted by mosquitoes. The larvae of D. aethiops of monkeys do not develop in the Malpighian tubes but in the body cavity and fat body of the mosquito (Webber, 1955).

Mosquitoes are the intermediate hosts of filariae which parasitize farm
54 animals, particularly of species of the genus Setaria, S. equina, S. marshalli, S. digitata, S. labiatopapillosa. As to the last species, there are data that the larvae also develop in bloodsucking flies.

Our knowledge of the vectors of filariae of wild animals is very incomplete. However, the role of mosquitoes of the genera Aedes, Armigeres, Culex, Mansonia and Anopheles as intermediate hosts of filariae which parasitize wild mammals, birds, reptiles and amphibians has been established. Mosquitoes are the intermediate hosts of 5 species of the genus Foleyella which parasitize frogs. The development of the microfilariae in the body cavity and the fat body of Culex pipiens fatigans, C. p. molestus and Aedes aegypti has been established. The feeding of mosquitoes on Amphibia is thus not rare but common.

Mosquitoes and arboviruses

Among the arboviruses of man and animals are viruses that reproduce in bloodsucking arthropods and are transmitted to vertebrates by the saliva of insects or mites. There are many such viruses: there were 155 in 1963, of which 117 were isolated from mosquitoes (Gordon Smith, 1964). This figure is increasing each year. Mosquitoes play a major role in the transmission of virus infections (see Mattingly, 1960; Chamberlain and Sudia, 1961; Reeves, 1962, 1965; Sazonova, 1962; Gordon Smith, 1964; Gutsevich, 1964; Pratt, 1964; also Viruses Transmitted by Arthropods [Russian], 1962).

Below is a list of the most important species of mosquitoes which transmit virus infections that have been well studied:

Disease	Main vectors
Yellow fever	In urban areas – Aedes aegypti; in natural foci – A. africanus Theob., A. simpsoni Theob. and other species of Stegomyia (Africa), Haemagogus sp., Aedes (Finlaya) leucocelaenus D. and Sh., Sabethes chloropterus Humb. and other species (South and Central America)
Dengue (dengue and Chikungunya viruses)	Aedes aegypti, A. albopictus and other species of Stegomyia
Japanese B encephalitis	Culex tritaeniorhynchus, C. gelidus Theob., C. vishnui Theob., C. pipiens, Aedes togoi and others
Murray Valley encephalitis	Culex annulirostris Sk. and others
West Nile encephalitis	Culex pipiens molestus, C. univittatus, C. antennatus Beck., Aedes aegypti and others
St. Louis encephalitis	Culex pipiens fatigans, C. tarsalis Coq.
Eastern equine encephalitis (America)	Culiseta melanura Coq., Aedes sollicitans Walk., A. vexans, Culex restuans Theob. and others

Western equine encephalitis (America)	Culex tarsalis
Venezuelan equine encephalitis	Mansonia perturbans Walk., M.titillans Walk. and others
California encephalitis	Aedes melanimon D., Culex tarsalis (probably)
O'nyong-nyong fever (Africa)	Anopheles funestus, A.gambiae

55 The role of mosquitoes as vectors is determined by the intensive multiplication of the virus in the insect and the accumulation of the virus in the salivary glands in an amount sufficient to infect the vertebrate.

Characteristic for most arboviruses is a broad range of invertebrate hosts. Mosquitoes of different genera, rarely species of one genus or subgenus, are potential carriers of the virus. The vectors of the virus of dengue are only a few species of Stegomyia. Under equal conditions the virus usually multiplies intensively in the mosquitoes of a certain species but less intensively or not at all in related species. Examples may be found in the publications cited.

Nearly all virus infections transmitted by mosquitoes have natural foci. Species of mosquitoes that rarely if ever attack man may have a distinct role in circulating the virus in natural foci. An example is Culiseta melanura Coq., which is a vector of the virus of eastern equine encephalitis among birds. Synanthropic species of mosquitoes spread the infection among people. This is the role of Aedes aegypti and A. albopictus as vectors of dengue. Species of mosquitoes with a broad range of hosts, feeding on man and on animals, may spread the virus among animals and also transmit it to man. Such species are Culex tarsalis, the vector of western equine encephalitis in North America, and C. tritaeniorhynchus and C. gelidus, vectors of Japanese B encephalitis in East and Southeast Asia.

If the mosquito-vectors feed on wild animals and on man, the virus may spread from natural foci to populated zones. An example is the outbreak of yellow fever in Ethiopia in 1960–1962, when more than 15,000 people were infected, with a mortality of about 85% (Sérié et al., 1964). The connection between the infected animals (monkeys) and people was apparently Aedes simpsoni, which lives in forests but also in habitations and areas near to habitations, and attacks both monkeys and man.

The part played by mosquitoes in the spread of viruses among wild animals has been little studied. Since some viruses are prevalent mainly among birds and others among mammals (rodents), the possible role of mosquitoes as vectors is determined to a large extent by their food preference.

Man is usually an accidental, facultative, link in the spread of viruses transmitted by mosquitoes, but this may take place on a wide scale in nature, as serological examinations of animals have shown. In determining the vectors of viruses, biological characters of mosquitoes, e.g. their mobility, frequency of bloodsucking and repetition of gonotrophic cycles, and possible mass development in a short time have to be considered. Some of these

characters may explain severe outbreaks of virus infections transmitted by mosquitoes. Such outbreaks were the epidemics of yellow fever in Europe and America and recently of O'nyong-nyong fever in East Africa
56 in 1959–1960 (more than one million people infected), the epidemic of dengue and the form of hemorrhagic fever (also caused by the virus of dengue) in Southeast Asia. The vectors in these epidemics were species closely connected with man: Aedes aegypti (dengue), Anopheles funestus, and A. gambiae (O'nyong-nyong fever).

Mosquitoes transmitting virus infections are most prevalent in the tropics but they also occur in temperate zones, e.g. some forms of encephalitis in North America and Japanese B encephalitis in East Asia.

The transmission of West Nile encephalitis is of special interest. The virus is apparently transmitted by mosquitoes and probably also by mites and ticks, Argasidae and Ixodidae. Foci of West Nile fever are known in Africa, Southwest Asia, India and also in Southern Europe, particularly in the South of France (where the virus was isolated from Culex modestus) and in the Volga delta.

In Czechoslovakia the role of mosquitoes in the transmission of tahynia virus (of the group of California encephalitis), isolated from Aedes caspius and A. vexans, was studied (Bárdoš and Danielová, 1959). The transmission of the virus by A. vexans and A. sticticus was proved experimentally, but the results were negative in experiments with A. cinereus (Šimková et al., 1960; Danielová, 1962). A virus was isolated from Anopheles maculipennis which was named "Čalovo" (Bárdoš and Danielová, 1962, Czechoslovakia) and belongs to the Bunyamvera group. Very similar if not identical viruses were isolated from Culex gelidus (batai virus) in Malaya and from A. barbirostris, A. tesselatus Theob., A. subpictus and Culex bitaeniorhynchus in India (Chittoor virus; Singh and Pavri, 1966). Viruses of the group of California encephalitis and Bunyamvera virus transmitted by mosquitoes are apparently also widely distributed in the USSR.

In the western Ukraine, some strains of lymphocytic choriomeningitis were isolated from Aedes communis, A. diantaeus, A. cantans and other species (Glushchenko et al., 1957; Vigovskii and Gutsevich, 1961). This virus may also belong to the group of arboviruses since its multiplication in arthropods had been proved (Rzhegachek, 1965). Many strains of viruses have been isolated from different species of mosquitoes in other parts of the USSR (Azerbaidzhan, Kazakhstan, etc.; Il'enko et al., 1962; Mirzoeva et al., 1964; Ananyan, 1965).

Mosquitoes as mechanical vectors of disease

In this form of transmission, the causative agent of the disease does not develop or multiply in the vector and it is transmitted without its participation.

The best studied example is the transmission of the bacteria of tularemia by mosquitoes and other bloodsucking insects. The bacteria remain alive in mosquitoes feeding on infected rodents for a long time (to one month;

Olsuf'ev and Golov, 1938). The transmission takes place by mechanical inoculation, feeding of the infected mosquito. The longer the interval between feeding on the infected and the healthy animal (man), the greater the possibility that the parasite will be transmitted. Transmission is also possible 57 by crushing the infected mosquito on the scarified skin of the animal (man). Mosquitoes evidently have a prominent role in spreading the bacteria of tularemia in natural foci and also in the infection of people during outbreaks of the infection (Olsuf'ev and Rudnev, 1960). The vectors may be mosquitoes, particularly of the genus Aedes (A. caspius, A. vexans, A. cinereus, A. excrucians, A. flavescens and also Mansonia richiardii and others). Infected mosquitoes have been repeatedly found in nature. Species of mosquitoes which feed preferably on rodents, which is especially characteristic for Aedes, are the main agents in the spread of tularemia.

Mosquitoes are also mechanical vectors of viruses which cause disease in animals: fowl pox, infectious myxomatosis, and others.

METHODS OF COLLECTION AND OF MOUNTING AND PRESERVING COLLECTIONS OF MOSQUITOES

ADULTS

Mosquitoes can be collected nearly everywhere and at any time of the year. In winter, the females of some species (especially of the genera Culex, Culiseta and Anopheles) hibernate in cellars, basements, caves and buildings containing animals. With the thawing of the snow, they leave their winter resting places and mass flights of mosquitoes which hibernated as eggs (Aedes) or as larvae (some Anopheles, Culiseta and others) take place at the end of spring. A new generation that hibernated as adults appears at the beginning of summer.

Resting and biting females are collected with an aspirator, with test tubes, or with an insect net. The males are found on flowers, especially on white Umbelliferae, mountain ash, rhubarb, on leaves of shrubs and trees or during swarming. They decrease in numbers in summer but at this time new forms appear. Most species of Culex, Anopheles, Aedes and others are best collected at the end of summer.

Methods ensuring complete, large and quantitative collections are widely used. The most exact results have been obtained by using a bell-trap net (Monchadskii and Radzivilovskaya, 1947), which is hung at a height of about 2 m with an observer as bait under it. The net is lowered after five minutes and the insects in it collected. Less exact results are obtained by the use of an aspirator to catch the insects flying around the observer for a certain time.

For quantitative calculation an insect net is used. The number of mosquitoes caught with 100 swings is taken as a unit (Olsuf'ev, 1939). The 58 mosquitoes should be removed from the net after every 10 swings to avoid damage. Less satisfactory results are achieved by swings through the vegetation as the insects are severely damaged. Other variations are huts, tents or canopies (Chinaev, 1959). People or animals are used as bait.

Light traps are used in quantitative catches. Electric lamps, ultraviolet or polarized light are the source of light (Breev, 1958, 1963; Zhogolev, 1959; Kovrov and Monchadskii, 1963; Zhogolev and Shcherbina, 1966). Light traps with suction devices (ventilators) are useful. Not all species of mosquitoes are attracted by light to the same degree, but this method gives valuable results since males are also collected.

To obtain well preserved specimens, mosquitoes are bred from larvae and pupae.

Potassium cyanide, chloroform and acetic and sulfuric ether are used to kill mosquitoes. The insects are placed in a jar with the above substances or placed in a test tube or aspirator together with absorbent cotton dipped in these liquids. Five to ten minutes (not longer) are sufficient to kill them. Mosquitoes hatching from pupae are killed a day after hatching when the integument has hardened.

The mosquitoes are pinned on thin entomological pins (Nos. 0, 00) or short, thin pins (minuten pins). The insect is placed on a piece of white paper with its back turned upward. Holding it with a fine pair of tweezers, the pin is inserted in the middle of the thorax slightly lateral to the median line. The pin is pushed into a cork plate to about $^2/_3$ of its length. Mosquitoes pinned on minuten pins are placed on a small rectangular piece of carton which is then fixed to an entomological pin (Nos. 1–2). Pinning mosquitoes from the side is also suitable. The label should give the locality, date, conditions of the locality and the name of the collector. The
59 mosquitoes are examined with the binocular microscope at a magnification of ×20–25.

If it is not possible to pin the material, the mosquitoes are placed on cotton in a box and covered with paper with the data for the label. Naphthalene is placed in the box. Before dried mosquitoes are pinned, they are placed in a moist chamber for 3–6 hours.

To determine the species of a mosquito it is often necessary to examine the genitalia of the male (hypopygium). The last segments of the abdomen are cut off and placed for a minute in 96° alcohol and then left for a few hours in 10% KOH. After they have been washed in water, they are passed through alcohols of increasing strength, dehydrated in 96° alcohol, cleared in oil of cloves or carbol xylene, and mounted in Canada balsam. The preparation is labeled with the same number or data as the pinned insect.

Further details on methods of collection and preservation are given by E. N. Pavlovskii (1935, 1959), A. S. Monchadskii (1952), and P. A. Petrishcheva (1964).

LARVAE

The collection of larvae is necessary in any study of mosquitoes and gives the most complete data on their specific composition, times of development, and typical breeding places. All natural and artificial water bodies, permanent or temporary, should be examined.

Inspections should begin in early spring, when the larvae of early spring species of Aedes, which hatch from hibernating eggs, are found.

Hibernating larvae of Culicella, Culiseta, Anopheles claviger and Mansonia richiardii will be found only in the middle or at the end of spring, when the water is free of ice and its temperature is 5–12°. Until then, they lie immobile at the bottom. In the middle of spring, the larvae of Aedes appear. When the birdcherry begins to blossom, pupation of the early spring species takes place and the larvae of the late spring species appear. At the end of spring, when the lilac blossoms, larvae hatch from eggs deposited by hibernating females of Anopheles, Culiseta and Culex.

Spring is the most important time for inspection, especially in the north and in the taiga, forest and forest-steppe of the USSR, because of the appearance of larvae of Aedes. In southern parts of the USSR, most species of Culex and Anopheles are found in summer and autumn. The typical
60 breeding places are inspected every 10–14 days, in the south (Caucasus and Middle Asia) every week. Other water bodies of the same type should be inspected every 3–4 weeks. Inspection for the larvae can be stopped from the middle of September, and in the south in early November.

The breeding place is approached without noise and without shadowing it. The larvae of many species (Anopheles claviger, A. superpictus, Aedes excrucians, Culiseta morsitans and others) are very sensitive to disturbances and rapidly descend to the bottom where they may remain for 10–15 minutes. In small water bodies roiling may cause the larvae to rise to the surface.

Nets are best for collecting larvae. The net should be 10–15 cm wide and its wire frame 3–5 mm thick and stiff. The rod should be 2 m long. The net is made of miller's gauze (Nos. 8–15) or fine-mesh,netting. Gauze is not suitable. The net should be rounded-conical. In conical nets the larvae accumulate at the bottom and are damaged. The net should not be more than 1.5 times longer than wide.

The net is submerged two-thirds in the water at a right angle and drawn along the surface for 2–3 m. It is then rapidly turned through 180°, at a depth of 10–15 cm, against the current.

To collect larvae in shallow or small water bodies, a wire hoop about 10 cm wide and covered with miller's gauze is effective. The larvae are washed in a dish with water. A dipper with a few small openings may also be used.

Special pumps or small nets about 5 cm wide may be used for tree holes. Several pumpings are necessary and part of the water must be returned to the hole.

The contents of the net are poured into a white enamel dish half filled with water from the breeding place. The larvae are placed in a jar and labeled.
61 The jar should be protected against direct sunlight and on hot days covered with a wet cloth or put into a case with layers of gauze and with cotton between the jars.

In the laboratory, the larvae are selected by species and stages. All pupae and some 4th-stage larvae are separated for the breeding of adult mosquitoes; the other larvae are preserved.

For the development of mature mosquitoes the larvae and pupae are placed singly or in a group of several in a small cylinder or in an Erlenmeyer flask half filled with water, preferably water from the breeding place, with a fresh green leaf placed on it. The vessels are protected against sunlight, covered with absorbent cotton and placed with their opening toward the source of light. The average length of the pupal stage is two days. The males pupate and hatch first.

Larvae of Anopheles are examined from the dorsal side, where most characters are distinct. Few characters (comb of the 8th segment, fin, caudal hairs and gills) are visible in lateral view.

Larvae of Culicinae are examined as follows: the anterior end from above, the posterior end laterally. The larvae are cut at abdominal segments 4–5. Preparations of whole larvae are not suitable for determination.

The larvae are preserved in 96° alcohol heated to 50–55°. This gives better preservation of the hairs and the stigmal plate.

For permanent preservation and transport, the larvae are placed in a small tube with a label inside. The tube is filled with 96° alcohol and is then stopped with absorbent cotton to prevent air bubbles and damage by shaking.

Gum solutions (Faure-Berlese) should not be used for permanent preparations. 62 This method is suitable only for rapid determination in the field. The treatment of larvae with KOH is useless and causes deterioriation of the preparations.

The larvae should be mounted in Canada balsam. They are pierced and transferred for 1–2 hours to absolute alcohol for complete dehydration. They are then placed in a clearing medium (oil of cloves, eugenol, terpineol) for 2–3 hours and mounted in Canada balsam. They are covered with a cover glass on pieces of wax about as high as the larvae are thick.

It is often necessary to make preparations of the shed skin of larvae. The skin is placed for a few minutes in 96° alcohol and transferred to lactic acid, where it softens. It is then placed on a slide and straightened under the binocular; the lactic acid is then suctioned off and replaced with 96° alcohol. The skin is then fixed. Mounting is as in Canada balsam preparations.

Larvae should be handled with care to avoid damage to the hairs, gills, etc. Live larvae are transferred with a pipette with a broad opening.

Bibliography

The literature on mosquitoes is very large. We have given only a short list. For details on the older literature on the USSR, the following are recommended: N. S. Shtakel'berg. Bibliografiya malyarii (epidemiologiya, perenoschiki, bor'ba s malyariei, organizatsiya protivomalyariinogo dela v SSSR) 1771–1935 (Bibliography of Mosquitoes (Epidemiology, Vectors, Control of Malaria, Organization of Anti-Malarial Measures in the USSR) 1771–1935). —Moskva–Leningrad, Izd. AN SSSR. 1940. 963 pp. Auxiliary Indexes. 1941. 136 pp. The work contains a complete list of the Russian literature on mosquitoes, with notes. The journal of abstracts "Biologiya" should be consulted (issue "Zooparazitologiya"), and also the annual lists published in "Meditsinskaya Parazitologiya i Parazitarnye Bolezni" (N. N. Dukhanina).

Recent catalogues and books in non-Russian literature are: A. Stone, K. L. Knight and H. Starcke. A Synoptic Catalog of the Mosquitoes of the World (Diptera, Culicidae). 1959; 38-page bibliography, mainly on systematics and faunistics. W. R. Horsfall. Mosquitoes. Their Bionomics and Relation to Disease 1955, 79-page bibliography, mainly on the biology
63 and medical importance of mosquitoes. M. Bates. The Natural History of Mosquitoes. 1949; 46-page bibliography, also mainly on the biology and medical importance of mosquitoes. A. N. Clements. The Physiology of Mosquitoes. 1963; 56-page bibliography, mainly on physiology and morphology.

Extensive bibliographies are contained in the monographs listed below.

For up-to-date non-Soviet references, see the following journals: Review of Applied Entomology, Ser. B (Medical and Veterinary), London; Tropical Diseases Bulletin, London.

A. MONOGRAPHS AND REGIONAL REPORTS

Publications in Russian

Beklemishev, V. N. Ekologiya malyariinogo komara (Anopheles maculipennis Mgn.) (Ecology of Anopheles maculipennis Mgn.). — Moskva, Medgiz. 1944. 299 pp.

Beklemishev, V. N. and N. K. Shipitsina (editors). Sezonnye yavleniya v zhizni malyariinykh komarov v Sovetskom Soyuze (Seasonal Phenomena in the Life of Anopheles in the Soviet Union). Moskva. 1957. 527 pp.

Maslov, A. V. Komary roda Culiseta (Mosquitoes of the Genus Culiseta). — Moskva—Leningrad, Izd. "Nauka." 1967. 182 pp.

Monchadskii, A. S. Lichinki komarov (sem. Culicidae) SSSR i sopredel'nykh stran (Larvae of the Culicidae of the USSR and Adjacent Countries). — Opredeliteli po faune SSSR, 24: 1—379. Moskva—Leningrad, Izd. AN SSSR. 1936.

Monchadskii, A. S. Lichinki krovososushchikh komarov SSSR i sopredel'nykh stran (podsem. Culicinae) (Larvae of Mosquitoes of the USSR and Adjacent Countries (Subfamily Culicinae)). — Ibid., 37: 1—290. Moskva—Leningrad, Izd. AN SSSR. 1951.

Monchadskii, A. S. and A. A. Shtakel'berg. Malyariinye komary Tadzhikistana i mery bor'by s nimi (Anophelines of Tadzhikistan and their Control). Stalinabad. 1943. 96 pp.

Shtakel'berg, A. A. Krovososushchie komary (sem. Culicidae) Soyuza SSR i sopredel'nykh stran (Culicidae of the Soviet Union and Adjacent Countries). — Opredeliteli po faune SSSR, 1: 1—170. Moskva—Leningrad, Izd. AN SSSR. 1927.

Shtakel'berg, A. A. Semeistvo Culicidae (The Family Culicidae). — Fauna SSSR, Nasekomye dvukrylye, 3(4): 1—257. Moskva—Leningrad, Izd. AN SSSR. 1937.

Publications in Other Languages

Barraud, P. J. Family Culicidae, Tribes Megarhinini and Culicini. — The Fauna of British India Including Ceylon and Burma. Diptera, 5: 1—463. London. 1934.

Bates, M. The Natural History of Mosquitoes. New York. 1949. 379 pp.

Carpenter, S. J. and W. J. La Casse. Mosquitoes of North America (North of Mexico). Berkeley and Los Angeles. 1955. 360 pp.

Christophers, S. R. Family Culicidae. Tribe Anophelini. — The Fauna of British India. Diptera, 4:1—371. London. 1933.

Christophers, S. R. Aedes aegypti (L.), the Yellow Fever Mosquito, its Life History, Bionomics and Structure. Cambridge. 1960. 739 pp.

Clements, A. N. The Physiology of Mosquitoes. International Series of Monographs on Pure and Applied Biology, Vol. 17: 1—393. Oxford. 1963.

Edwards, F. W. A Revision of the Mosquitoes of the Palaearctic Region. — Bull. Ent. Res., 12 (3): 263—351. 1921.

Edwards, F. W. Una revisione delle zanzare delle regioni Palaeartiche. — Riv. Malar., 5 (3/6): 1—152. 1926.

Edwards, F. W. Fam. Culicidae. Genera insectorum, dirigés par Wytsman. Diptera, fasc. 194. Bruxelles. 1932. 258 pp.

Edwards, F. W. Mosquitoes of the Ethiopian Region. III. Culicinae Adults and Pupae. London. 1941. 499 pp.

Evans, A. M. Mosquitoes of the Ethiopian Region. II. Anophelini Adults and Early Stages. London. 1938. 404 pp.

Feng, L. C. et al. Mosquitoes of China. Shanghai. 1958. 250 pp. (In Chinese.)

Foote, R. H. and D. R. Cook. Mosquitoes of Medical Importance. — Agric. Handb. (U.S. Dep. Agric.). 152. Washington. 1959. 158 pp.

Gjullin, C. M., R. J. Sailer, A. Stone, and B. V. Travis. The Mosquitoes of Alaska. — Ibid., 182. Washington. 1961. 98 pp.

Hopkins, G. H. Mosquitoes of the Ethiopian Region. I. Larval Bionomics of Mosquitoes and Taxonomy of Culicinae Larvae. 2nd edition. London. 1952. 355 pp.

Horsfall, W. R. Mosquitoes, their Bionomics and Relation to Disease, New York. 1955. 723 pp.

Kirkpatrick, T. W. The Mosquitoes of Egypt. Cairo. 1925. 224 pp.

Kramář, J. Komáří bodaví — Culicinae. — Fauna ČSR, 13. Praha. 1958. 286 pp.

La Casse, W. J. and S. Yamaguti. Mosquito Fauna of Japan and Korea, pp. 1—268, 1—213. Kyoto. 1955.

Lang, W. D. A Handbook of British Mosquitoes. London. 1920. 125 pp.

Marshall, J. F. The British Mosquitoes. London. 1920. 341 pp.

Martini, E. Über Stechmücken besonders deren europäische Arten und ihre Bekämpfung. Leipzig. 1920. 267 pp.

Martini, E. Culicidae. — In: E. Lindner, Die Fliegen der Palaearktischen Region, 11 and 12. Stuttgart. 1929—1931. 398 pp.

Matheson, R. Handbook of the Mosquitoes of North America. 2nd edition. Ithaca. 1944. 314 pp.

Mihályi, F. and M. Gulyás. Magyarország csipő szúnyogjai. Budapest 1963. 229 pp. (In Hungarian.)

Natvig, L. R. Contributions to the Knowledge of the Danish and Fennoscandian Mosquitoes.— Culicini. Oslo. 1948. 567 pp.

Peus, F. Die Fiebermücken des Mittelmeergebiets. Leipzig. 1942. 150 pp.

Puri, J. M. Larvae of Anopheline Mosquitoes, with Full Description of those of the Indian Species. — Indian Med. Res. Mem., Vol. 21: 1—225. 1931.

Rioux, J. A. Les Culicidés du "Midi" Méditerranéen. — Encycl. ent. (A), Vol. 35: 1—303. 1958.

Séguy, E. Les moustiques de France. — Encycl. prat. Nat., Vol. 19: 1—225. 1923.

Senevet, G. Les Anophèles du Globe. — Ibid., Vol. 36: 1—215. 1958.

Senevet, G. and L. Andarelli. Les Anophèles de l'Afrique du Nord et du Bassin Méditerranéen. — Ibid., Vol. 33: 1—280. 1955.

Senevet, G. and L. Andarelli. Les moustiques de l'Afrique du Nord et du Bassin Méditerranéen; les genres Culex, Uranotaenia, Theobaldia, Orthopodomyia et Mansonia.— Ibid., Vol. 37: 1—384. 1959.

Snodgrass, R. E. The Anatomical Life of the Mosquito. — Smithson. Misc. Collns., 139 (8): 1—87. 1959.

Stone, A., K. L. Knight, and H. Starcke. A Synoptic Catalog of the Mosquitoes of the World (Diptera, Culicidae). — The Thomas Say Foundation, 6. Washington. 1959. 358 pp.

Wesenberg-Lund, C. Contributions to the Biology of the Danish Culicidae. — K. danske Vidensk. Selsk. Skr., Vol. 7: 1—210. 1921.

B. SYSTEMATICS, FAUNISTICS, MORPHOLOGY, BIOLOGY

Publications in Russian

Alektorov, A. A. K faune komarov Culicidae Dal'nevostochnogo kraya SSSR (On the Fauna of the Family Culicidae of the Soviet Far East).— Parazitologicheskii Sbornik Zoologicheskogo Instituta SSSR, Vol. 2: 229—248. 1931.

Bashkareva, A. L. Nekotorye dannye o malyariinykh i drugikh komarakh Sochinskogo raiona (Some Data on Anophelines and Other Mosquitoes of the Sochi Region). — Ibid., pp. 55—58.

Blagoveshchenskii, D. I. Materialy po faune naruzhnykh parazitov (Arthropoda) zhivotnykh Kazalinskogo i nekotorykh drugikh raionov yuzhnogo Kazakhstana (Data on the Fauna of External Parasites (Arthropoda) of Animals of the Kazalinsk Region and Other Regions in Southern Kazakhstan). — In Sbornik: "O vreditelyakh zhivotnovodstva v Kazakhstane," pp. 11—84. Moskva—Leningrad, Izd. AN SSSR. 1937.

Bozhkov, D. K. Krovososushchie komari (Diptera, Culicidae) Bolgarii (Mosquitoes (Diptera, Culicidae) in Bulgaria). — Entomologicheskoe Obozrenie, 45 (3): 570—574. 1966.

Bregetova, N. G. Aktivnost' napadeniya na cheloveka i ee sutochnyi ritm u komarov Aedes caspius caspius (Pall.) Edw. i Aedes vexans Meig. v prirodnykh usloviyakh yuzhnogo Tadzhikistana (Activity of Attack on Man and its Diurnal Rhythm in Mosquitoes Aedes caspius caspius (Pall.) Edw. and Aedes vexans Meig. under Natural Conditions of Southern Tadzhikistan). — Izvestiya AN SSSR, Seriya Biologicheskaya, Nos. 2—3: 251—279. 1946.

Breev, K. A. O primenenii lovushek ul'trafioletovogo sveta dlya opredeleniya vidovogo sostava i chislennosti populyatsii komarov (Use of Ultraviolet Light Traps for Determination of the Specific Composition and Population of Mosquitoes). — Parazitologicheskii Sbornik Zoologicheskogo Instituta AN SSSR, Vol. 18: 219—238. 1958.

Breev, K. A. Vliyanie istochnikov sveta na chislennost' i vidovoi sostav komarov, sobiraémykh v svetovye lovushki (The Effect of Light on the Population and Specific Composition of Mosquitoes Collected in Light Traps). — Entomologicheskoe Obozrenie, 42 (2): 280—303. 1963.

Chagin, K. P. Nablyudeniya nad tsiklom razvitiya Aedes (F.) togoi v laboratornykh i prirodnykh usloviyakh (Observations on the Cycle of Development of Aedes (F.) togoi in the Laboratory and in Nature). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 12 (2): 44—52. 1943.

Chinaev, P. P. Metody kolichestvennogo ucheta krovososushchikh komarov (Diptera, Culicidae) (Methods of a Quantitative Census of Mosquitoes (Diptera, Culicidae)). — Entomologicheskoe Obozrenie, 38 (4): 757—765. 1959.

Denisova, Z. M. Izmenchivost' gipopigiev Anopheles maculipennis messeae Fall. v populyatsii Marbumstroya (Mariiskaya ASSR) (Variability of the Hypopygium of Anopheles maculipennis messeae Fall. in Marbumstroi (Mari ASSR)). — In Sbornik: "Voprosy fiziologii i ekologii malyariinogo komara," Vol. 1: 113—119. 1940.

Denisova, Z. M. Materialy po izucheniyu variatsii gipopigiev samtsov Anopheles maculipennis atroparvus Thiel i Anopheles maculipennis sacharovi Favre (A Study of the Variation of the Hypopygium of Males of Anopheles maculipennis atroparvus Thiel and Anopheles maculipennis sacharovi Favre). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 3 (17): 221—227. 1948.

Denisova, Z. M. Novyi vid Aedes (Ochlerotatus) (A New Species of Aedes (Ochlerotatus)). — Ibid., 24 (1): 58—61. 1955.

Denisova, Z. M. Variatsii gipopigiev samtsov nekotorykh podvidov malyariinogo komara Anopheles maculipennis Mg. (Diptera, Culicidae) (Variation of the Hypopygium in Males of Some Subspecies of Anopheles maculipennis Mg. (Diptera, Culicidae)). — Entomologicheskoe Obozrenie, 43 (4): 815—822. 1964.

Enikolopov, S. K. Ob ekologii Anopheles algeriensis Theob. (On the Ecology of Anopheles algeriensis Theob.). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 6 (3): 354—359. 1937.

Fedorov, V. G. K obnaruzheniyu Culex molestus Forskål v Leningrade (On the Finding of Culex molestus Forskål in Leningrad). — Ibid., 15 (2): 58—67. 1946.

Fridolin, V. Yu. Zhivotno-rastitel'noe soobshchestvo gornoi strany Khibin (Animal and Plant Communities in the Khibiny Mountains). — Trudy Kol'skoi Bazy AN SSSR, Vol. 3: 1—295. 1936.

Glagoleva, E. M. Nekotorye dannye po ekologii lichinok Anopheles v Tadzhikistane. I. Biotopy Anopheles algeriensis Theob. II. Biotopy Anopheles lindesayi Giles i Anopheles marteri Sen. Prun. III. Biotopy Anopheles bifurcatus. IV. Biotopy Anopheles pulcherrimus Theob. (Data on the Ecology of Anopheles Larvae in Tadzhikistan. I. Biotopes of Anopheles algeriensis Theob. II. Biotopes of Anopheles lindesayi Giles and Anopheles marteri Sen. Prun. III. Biotopes of Anopheles bifurcatus. IV. Biotopes of Anopheles pulcherrimus Theob.). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 13 (4): 58—64 and 65—67; 13 (5): 47—52; 13 (6): 41—44. 1944.

Glagoleva, E. M. Ob ekologii lichinok Anopheles v Tadzhikistane (On the Ecology of Anopheles Larvae in Tadzhikistan). — Ibid., 15 (5): 60—67. 1946.

Gutsevich, A. V. Novye i malo izvestnye formy komarov (New and Little-Known Forms of Mosquitoes). — Trudy Zoologicheskogo Instituta AN SSSR, Vol. 18: 320—324. 1955.

Gutsevich, A. V. Novyi vid krovososushchego komara roda Aedes (Diptera, Culicidae) iz Kazakhstana (A New Species of Aedes (Diptera, Culicidae) from Kazakhstan). — Entomologicheskoe Obozrenie, 41 (4): 886—888. 1962.

Gutsevich, A. V. Novyi vid komara iz Uzbekistana — Aedes (Ochlerotatus) simanini (Culicidae) (A New Species of Mosquito from Uzbekistan — Aedes (Ochlerotatus) simanini (Culicidae)). — Zoologicheskii Zhurnal, 45 (3): 457—459. 1966.

Gutsevich, A. V., Z. S. Donets, G. G. Ezhova, and A. M. Popov. Krovososushchie komary (Diptera, Culicidae) Chernovitskoi oblasti (Mosquitoes (Diptera, Culicidae) of the Chernovtsy Region). — Entomologicheskoe Obozrenie, 41 (2): 355—358. 1962.

Kalmykov, E. S. Izmeneniya v rasprostranenii malyariinykh komarov v svyazi s khozyaistvennoi deyatel'nost'yu cheloveka (Changes of the Distribution of Anopheline Mosquitoes in Relation to the Economic Activity of Man). — Nauchnye Trudy po Parazitologii, pp. 55—61. Dushanbe, Izd. "Irfon." 1965.

Kazantsev, B. N. K voprosu ob izmenchivosti risunka i okraski kryl'ev komarov roda Anopheles Srednei Azii (Variation of the Pattern and Coloration of the Wings of the Genus Anopheles in Middle Asia). — Parazitologicheskii Sbornik Zoologicheskogo Instituta AN SSSR, Vol. 1: 229—235. 1930.

Kazantsev, B. N. Tsvetovye variatsii bukharskikh Aedes caspius (Color Variation of Aedes caspius in Bukhara). — Ibid., Vol. 2: 85—90. 1931.

Keshish'yan, M. N. Culicidae Tadzhikistana (Culicidae of Tadzhikistan).— Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 10 (1): 77—80. 1941.

Khelevin, N. V. Vliyanie vneshnikh uslovii na vozniknovenie embrional'noi diapauzy i na kolichestvo pokolenii u Aedes caspius dorsalis Mg. (Diptera, Culicidae) v techenie sezona (Influence of the Environment on the Embryonic Diapause and Number of Generations in Aedes caspius dorsalis Mg. (Diptera, Culicidae) during a Season). — Entomologicheskoe Obozrenie, 37 (1): 24—47. 1958.

Kovrov, B. G. and A. S. Monchadskii. O vozmozhnosti primeneniya polyarizovannogo sveta dlya privlecheniya nasekomykh (On the Use of Polarized Light to Attract Insects). — Ibid., 42 (1): 49—55. 1963.

Lisova, A. I. Materialy po faune komarov sem. Culicidae goroda Tashkenta i ego okrestnostei (Data on the Fauna of Culicidae of Tashkent and its Vicinity). — Parazitologicheskii Sbornik Zoologicheskogo Instituta AN SSSR, Vol. 5: 27—54. 1935.

Lobkova, M. P. Nekotorye dannye po rasprostraneniyu komarov (podsemeistvo Culicinae) v Karelii (Data on the Distribution of Mosquitoes (Subfamily Culicinae) in Karelia). — In Sbornik: "K prirodnoi ochagovosti parazitarnykh i transmissivnykh zabolevanii v Karelii," pp. 108—119. Moskva—Leningrad, Izd. "Nauka." 1964.

L'vov, D. K. O vidovoi samostoyatel'nosti komara-perenoschika yaponskogo entsefalita Aedes esoensis Yam. (Diptera, Culicidae) (On the Specific Status of the Vector of Japanese Encephalitis, Aedes esoensis Yam. (Diptera, Culicidae)). — Entomologicheskoe Obozrenie, 35 (4): 929—934. 1956.

Markovich, N. Ya. Novye dannye po biologii Anopheles bifurcatus (nablyudeniya na Severnom Kavkaze (New Data on the Biology of Anopheles bifurcatus in the Northern Caucasus). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 10 (3/4): 410—413. 1941.

Martini, E. Komary Srednego Povolzh'ya (Mosquitoes of the Middle Volga Region). — Izvestiya AN SSSR, VI Seriya, 20 (9): 607—618. 1926.

Maslov, A. V. Izmenchivost' i sistematika Pallasova malyariinogo komara (Variability and the Systematics of Pallas Anophelines). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 15 (6): 39—46. 1946.

Maslov, A. V. O sistematike krovososushchikh komarov gruppy Culiseta (Diptera, Culicidae) (On the Systematics of Mosquitoes of the Group Culiseta (Diptera, Culicidae)). — Entomologicheskoe Obozrenie, 48 (1): 193—216. 1964.

Monchadskii, A. S. K poznaniyu lichinok komarov (Diptera, Culicidae). II. Novye i maloizvestnye lichinki komarov Dal'nego Vostoka (On the Larvae of Mosquitoes (Diptera, Culicidae). II. New and Little-Known Larvae of Mosquitoes of the Far East). — Parazitologicheskii Sbornik Zoologicheskogo Instituta AN SSSR, Vol. 9: 167—180. 1947.

Monchadskii, A. S. Lichinki Finlaya (Diptera, Culicidae) iz dupel derev'ev (Larvae of Finlaya (Diptera, Culicidae) from Tree Holes). — Ibid., Vol. 11: 253—261. 1949.

Monchadskii, A. S. Letayushchie krovososushchie dvukrylye-gnus (Bloodsucking Insects). — Moskva—Leningrad, Izd. AN SSSR. 1952.

Monchadskii, A. S. and Z. A. Radzivilovskaya. Novyi metod kolichestvennogo ucheta aktivnosti napadeniya krovososov (A New Method for a Quantitative Calculation of the Rate of Attack of Bloodsucking Insects). — Parazitologicheskii Sbornik Zoologicheskogo Instituta AN SSSR, Vol. 9: 147—166. 1947.

Olsuf'ev, N. G. Vidovoi sostav i sezonnaya dinamika chislennosti krovososushchikh dvukrylykh v del'te Volgi i ikh vozmozhnaya rol' v epidemiologii tulyaremii (Specific Composition and Seasonal Dynamics of Bloodsucking Insect Populations in the Volga Delta and their Possible Role in the Epidemiology of Tularemia). — Zoologicheskii Zhurnal, 18(5): 786—798. 1939.

Pavlovskii, E. N. Metody izucheniya krovososushchikh komarov (Culicidae) (Methods of Studying Mosquitoes (Culicidae)). 2nd edition, pp. 1—176. — Moskva—Leningrad, Izd. AN SSSR. 1935.

Pavlovskii, E. N. (editor). Laboratornyi praktikum meditsinskoi parazitologii (Komary) (Laboratory Course of Medical Parasitology (Mosquitoes)), pp. 200—249. — Leningrad, Medgiz. 1959.

Petrishcheva, P. A. Fauna, ekologiya i biologiya Culicidae Turkmenii (Fauna, Ecology and Biology of the Culicidae of Turkmenia). — Parazitologicheskii Sbornik Zoologicheskogo Instituta AN SSSR, Vol. 6: 49—115. 1936.

Petrishcheva, P. A. O krovososushchikh komarakh Primor'ya (Mosquitoes of the Maritime Territory). — In: Parazitologiya Dal'nego Vostoka, pp. 144—159. Leningrad, Medgiz. 1947.

Petrishcheva, P. A. Metody izucheniya prirodnykh ochagov boleznei cheloveka (komary) (Methods of Studying Natural Foci of Human Diseases (Mosquitoes)), pp. 12—35. — Moskva, Izd. "Meditsina." 1964.

Prendel', A. R. Proiskhozhdenie i kharakteristika fauny krovososushchikh komarov UkrSSR (Origin and Characteristics of the Fauna of Mosquitoes in the Ukraine). — In Sbornik: "Kraevaya parazitologiya i prirodnaya ochagovost' transmissivnykh boleznei," pp. 91—96. Kiev. 1966.

Remm, Kh. Ya. Materialy po faune i ekologii komarov (Diptera, Culicidae) Estonskoi SSR (Data on the Fauna and Ecology of Mosquitoes (Diptera, Culicidae) in Estonia). — Entomologicheskoe Obozrenie, 36(1): 148—160. 1957.

Saf'yanova, V. M. Materialy po ekologii krovososushchikh komarov Vladimirskoi oblasti (Data on the Ecology of Mosquitoes of the Vladimir Region). — Zoologicheskii Zhurnal, 39(2): 236—243. 1960.

Sazonova, O. N. Novyi vid krovososushchego komara roda Aedes Mg. (Diptera, Culicidae) iz evropeiskoi chasti SSSR (A New Species of Aedes Mg. (Diptera, Culicidae) from the European USSR). — Parazitologicheskii Sbornik Zoologicheskogo Instituta AN SSSR, Vol. 16: 148—151. 1956.

Sazonova, O. N. Tablitsa dlya opredeleniya samok komarov roda Aedes Mg. (Diptera, Culicidae) lesnoi zony SSSR (Key for the Determination of Females of Aedes Mg. (Diptera, Culicidae) of the Forest Zone of the USSR). — Entomologicheskoe Obozrenie, 37(3): 741—752. 1958.

Shingarev, N. I. Zametki po Culicidae III. (Notes on the Family Culicidae. III.). — Russkii Zhurnal Tropicheskoi Meditsiny, Vol. 6: 47—53. 1928.

Shlenova, M. F. Biologiya vazhneishikh vidov Aedes v srednei polose evropeiskoi chasti SSSR (Biology of the Important Species of Aedes in the Central European USSR). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 28 (2): 193—198. 1959.

Solovei, V. Ya. and V. G. Likhoded. K faune i ekologii krovososushchikh dvukrylykh (Diptera) severo-zapadnoi chasti Murmanskoi oblasti (On the Fauna and Ecology of Bloodsucking Insects (Diptera) in the Northwestern Murmansk Region). — Entomologicheskoe Obozrenie, 45 (3): 565—569. 1966.

Val'kh, S. B. K poznaniyu fauny Culicidae vostoka Ukrainy (On the Fauna of Culicidae in the Eastern Ukraine). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, Vol. 28 (6): 687—695. 1959.

Velichkevich, A. I. K faune i ekologii komarov Yuzhnogo berega Kryma (On the Fauna and Ecology of Mosquitoes of the Southern Coast of the Crimea). — Parazitologicheskii Sbornik Zoologicheskogo Instituta AN SSSR, Vol. 6: 137—145. 1936.

Vinogradova, E. B. Morfologicheskaya i biologicheskaya kharakteristika nekotorykh prirodnykh populyatsii krovososushchikh komarov Culex pipiens L. (Diptera, Culicidae) na territorii SSSR (Morphological and Biological Characteristics of Some Natural Populations of Culex pipiens L. (Diptera, Culicidae) in the USSR). — In Sbornik: "Ekologiya vrednykh nasekomykh i entomofagov"; Trudy Zoologicheskogo Instituta AN SSSR, Vol. 36: 31—57. 1965.

Vinogradova, E. B. Krovososushchie komary kompleksa Culex pipiens L. (Diptera, Culicidae), ikh prakticheskoe znachenie, sistematika i biologiya (Mosquitoes of the Culex pipiens L. Complex (Diptera, Culicidae), their Practical Importance, Systematics and Biology). — Entomologicheskoe Obozrenie, 45 (2): 241—257. 1966.

Vinogradskaya, O. N. Stigmal'nyi apparat Anopheles i ego vidoizmeneniya v zavisimosti ot sukhoustoichivosti i vlagolyubivosti vidov (The Spiracular Apparatus of Anopheles and its Variation in Relation to the Tolerance of Aridity and Hygrophily of Species). — Ibid., 31 (1/2): 151—154. 1950.

Vinogradskaya, O. N. Uchastie trakheinoi sistemy v isparenii vody u Anopheles maculipennis messeae Fall. i sezonnaya izmenchivost' dykhal'tsevogo indeksa u vidov podsemeistva Culicinae (Diptera, Culicidae) (Participation of the Tracheal System in the Evaporation of Water in Anopheles maculipennis messeae Fall. and the Seasonal Variation of the Spiracular Index in Species of Culicinae (Diptera, Culicidae)). — Ibid., Vol. 33: 157—160. 1953.

Volkova, M. I. Fauna krovososushchikh komarov (sem. Culicidae) doliny srednei Volgi v predelakh Tatarskoi ASSR (The Fauna of Mosquitoes (Culicidae) of the Middle Volga Valley in the Tatar ASSR). — Uchenye Zapiski Kazanskogo Gosudarstvennogo Universiteta, 116 (5): 153—156. 1956.

Vol'ftrub, A. M. K voprosu o vidovom sostave i dinamike aktivnosti krovososushchikh dvukrylykh nasekomykh v Taimyrskom natsional'nom okruge (On the Specific Composition and Dynamics of Activity of Bloodsucking Insects in the Taimyr Region). — Trudy Nauchno-Issledovatel'skogo Instituta Sel'skogo Khozyaistva Krainego Severa, Vol. 11: 113—116. 1963.

Zdrodovskii, P. F. Malyariya na Mugani. Epidemiologiya i plan bor'by (Malaria in the Mugan Steppe. Epidemiology and Control). Moskva—Baku. 1926. 174 pp.

Zhogolev, D. T. Svetovye lovushki kak metod sobiraniya i izucheniya nasekomykh — perenoschikov vozbuditelei boleznei (Light Traps for the Collection and Study of Insects — Vectors of Pathogenic Agents). — Entomologicheskoe Obozrenie, 38 (4): 766—773. 1959.

Zhogolev, D. T. and V. P. Shcherbina. Novaya model' portativnoi svetovoi lovushki dlya sbora krovososushchikh dvukrylykh nasekomykh (A New Model of Portable Light Trap for the Collection of Bloodsucking Insects). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 35 (5): 619—621. 1966.

Publications in Other Languages

Bates, M. The Nomenclature and Taxonomic Status of the Mosquitoes of the Anopheles maculipennis Complex. — Ann. Ent. Soc. Am., Vol. 33: 343—356. 1940.

Buonomini, G. and M. Mariani. World Anophelines Belonging to the Subgenus Maculipennia Buonomini e Mariani, 1946. — Riv. Malar., Vol. 32: 173—188. 1953.

Callot, J. and J. A. Rioux. Liste sommaire des Culicidés de France. — Annls. Parasit. hum. comp., 40 (2): 242—245. 1965.

Colless, D. H. Notes on the Culicine Mosquitoes of Singapore. IV. The Aedes niveus Subgroup (Diptera, Culicidae): Introduction and Description of Five New Species and of One New Subspecies. — Ann. Trop. Med. Parasit., 52 (4): 468—483. 1958.

Coluzzi, M. and C. Contini. The Larva and Pupa of Mansonia (Coquillettidia) buxtoni (Edwards), 1923 (Diptera, Culicidae). — Bull. Ent. Res., 53 (2): 215—218. 1962.

Corbet, P. S. Reproduction in Mosquitoes of the High Arctic. — Proc. XII Intern. Congress of Entomology, pp. 817—818. 1965.

Dabrowska, P. E. Communities of Mosquitoes in Three Types of Forest Land. — Ekol. polska, A, 12 (36): 737—783. 1964.

Dodge, H. R. Supergeneric Groups of Mosquitoes. — Mosquito News, 22 (4): 365—368. 1962.

Edwards, F. W. Oligocene Mosquitoes in the British Museum, with a Summary of Our Present Knowledge Concerning Fossil Culicidae. — Q. Jl. Geol. Soc. Lond., Vol. 79: 139—155. 1923.

Feng, L. C. The Tree Hole Species of Mosquitoes of Peiping, China. — China Med. J., Suppl., Vol. 2: 503—525. 1938.

Gordon, R. M. and W. H. R. Lumsden. A Study of the Behavior of the Mouthparts of Mosquitoes When Taking up Blood from Living Tissue Together with Some Observations on the Ingestion of Microfilariae. — Ann. Trop. Med. Parasit., Vol. 33: 259—278. 1939.

Jobling, B. On Two Subspecies of Culex pipiens. — Trans. R. Ent. Soc. Lond., 87 (8): 246—248. 1938.

Kramář, J. Culex territans v ČSR. — Čslká. Parasit., Vol. 4: 201—204. 1957.

Mariani, M., C. Bruno-Smiraglia, and N. Caravaglios. Ricerche sulla interspecificitá labranchiae-atroparvus. — Riv. Malar., 43 (1/3): 37—50. 1964.

Martini, E. Beiträge zur medizinischen Entomologie und zur Malaria-Epidemiologie des unteren Wolgagebiets. — Abh. Geb. Auslandsk., (Die Stechmückenfauna), Vol. 29: 21—69. 1928.

Mattingly, P. F. A Change of Name among the British Mosquitoes (Diptera, Culicidae). — Proc. R. Ent. Soc. Lond., B, Vol. 22: 106—108. 1953.

Mattingly, P. F. Le sous-genre Neoculex (Diptera, Culicidae) dans la sous-région méditerranéenne. I. Espèce, sous-espèce et synonymie nouvelles. — Annls. Parasit. hum. comp., Vol. 30: 375—388. 1955.

Mattingly, P. F., L. E. Rozeboom, K. L. Knight, P. G. Shute, F. H. Drummond, and S. R. Christophers. The Culex pipiens Complex. — Trans. R. Ent. Soc. Lond., 102 (7): 331—342. 1951.

Peus, F. Zur Kenntnis der Aedes-Arten des deutschen Faunengebietes (Diptera, Culicidae). Die Weibchen der Aedes communis-Gruppe. — Konowia, Vol. 12: 145—159. 1933.

Reid, J. A. The Anopheles hyrcanus Group in South-East Asia (Diptera, Culicidae). — Bull. Ent. Res., 44 (1): 5—76. 1953.

Reid, J. A. and K. L. Knight. Classification within the Subgenus Anopheles (Diptera, Culicidae). — Ann. Trop. Med. Parasit., 55 (4): 474—488. 1961.

Rioux, J.-A. and M. Arnold. Les culicidés de Camargue (Etude systématique et écologique). — Terre Vie, Vol. 4: 244—286.

Risler, H. Das Gehörorgan der Männchen von Culex pipiens L., Aedes aegypti L. und Anopheles stephensi Liston (Culicidae). — Zool. Jber. Neapel., Sec. 2, Vol. 74: 478—490. 1955.

Roubaud, E. and S. Ghelovitch. Observations sur le moustique anthropophile méditerranéen du groupe pipiens, Culex berbericus Roub. — C. r. hébd. Séanc. Acad. Sci., Paris, 242 (25): 2900—2903. 1956.

Seminar on the Ecology, Biology and Control of the Culex pipiens Complex. — World Health Organisation (Vector Control), Vol. 125: 1—217. 1965.

Senevet, G. and L. Andarelli. Les moustiques de l'Afrique du Nord et du bassin méditerranéen. — Arch. Inst. Pasteur Algér., Vol. 41: 115—172. 1963; Vol. 42: 94—192. 1964.

Senior-White, R. Notes on Ceylon Mosquitoes. II. The Larvae of the Commoner non-Anopheline Mosquitoes. — Spolia zeylan., (B), Vol. 14: 61—76. 1927.

Skierska, B. Przegląd piśmiennictwa dotyczącego komarów (Culicidae) z obszarów Polski oraz rejestracja i rejonizacja tych owadów na terenie naszego kraju. — Wiad. parazyt., 9 (6): 579—597. 1963.

Slifer, E. H. and S. S. Sekhom. The Fine Structure of the Sense Organs of the Antennal Flagellum of the Yellow Fever Mosquito Aedes aegypti (Linnaeus). — J. Morph., 111 (1): 49—66. 1962.

Stackelberg, A. A. A New Species of Finlaya Theob. (Diptera, Culicidae) from Ussuri Land. — Bull. Ent. Res., 34 (4): 311. 1943.

Trpiš, M. Typologie der Biotope in der Ostslowakei gemäss der Gesellschaften von Larven und Imagines der Stechmücken. — Entomologické Problémy, Vol. 5: 9—69. Bratislava. 1965a.

Trpiš, M. Verbreitung der Stechmücken (Diptera, Culicidae) in der Ostslowakei. — Ibid., pp. 71—100. 1965b.

Vockeroth, J. R. Specific Characters in Tarsal Claws of Some Species of Aedes (Diptera, Culicidae). — Can. Ent., Vol. 82: 160—162. 1950.

Vockeroth, J. R. The Specific Status of Aedes pionips Dyar (Diptera, Culicidae). — Ibid., Vol. 84: 243—247. 1952.

Vockeroth, J. R. Notes on Northern Species of Aedes, with Descriptions of Two New Species (Diptera, Culicidae). — Ibid., Vol 86: 109—116. 1954.

C. MOSQUITOES AS VECTORS

Publications in Russian

Ananyan, S. A. Novye dlya SSSR, peredayushchiesya komarami, vozbuditeli virusnykh infektsii (New Causative Agents of Infections Transmitted by Mosquitoes in the USSR). — In Sbornik: "Aktual'nye problemy virusnykh infektsii"; Materialy XII nauchnoi sessii Instituta poliomielita i virusnykh entsefalitov, pp. 194—195. Moskva. 1965.

Bárdoš, V. and E. Čupková. Virus Čalovo — vtoroi arbovirus, vydelennyi iz komarov v Chekhoslovakii (Čalovo Virus — the Second Arbovirus Isolated from Mosquitoes in Czechoslovakia). — Zhurnal Gigieny, Epidemiologii, Mikrobiologii, Immunologii, Vol. 6: 255—260. Praha. 1962.

Bárdoš, V. and V. Danielová. Virus Ťahyňa — virus, vydelennyi iz komarov v Chekhoslovakii (Ťahyňa Virus, Isolated from Mosquitoes in Czechoslovakia). — Ibid., Vol. 3 (2): 182—193. Praha. 1959.

Beklemishev, V. N. O faktorakh, opredelyayushchikh znachenie razlichnykh vidov Anopheles kak perenoschikov malyarii (Factors Determining the Importance of Different Species of Anopheles as Vectors of Malaria). — Meditsinskaya Parazitologiya i Parazitarnye Bolezni, 10 (1): 5—8. 1941.

Beklemishev, V. N. Ekologiya malyariinogo komara (Anopheles maculipennis Mgn.) (The Ecology of Anopheles maculipennis Mgn.). — Moskva, Medgiz. 1944. 299 pp.

Detinova, T. S. Metody ustanovleniya vozrastnogo sostava dvukrylykh nasekomykh, imeyushchikh meditsinskoe znachenie (Methods for the Determination of the Age Composition of Medically Important Diptera). — World Health Organisation. Geneva. 1962. 220 pp.

Glushchenko, P. A., A. V. Gutsevich, and M. S. Dudkina. Issledovanie komarov kak perenoschikov virusa limfotsitarnogo khoriomeningita na zapade Ukrainy (A Study of Mosquitoes as Vectors of the Virus of Lymphocytic Choriomeningitis in the Western Ukraine). — DAN SSSR, 113 (5): 1181—1183. 1957.

Gutsevich, A. V. Nasekomye kak perenoschiki virusov — parazitov cheloveka i zhivotnykh (Insects as Vectors of Viruses — Parasites of Man and Animals). — Zoologicheskii Zhurnal, 43 (3): 429—442. 1964.

Il'enko, V. I., A. N. Sterkhova, N. M. Mirzoeva, K. A. Dyunina, and M. G. Akhundov. Materialy po izucheniyu transmissivnykh virusnykh infektsii v nekotorykh raionakh Azerbaidzhanskoi SSR (A Study of Transmissible Virus Infections in Some Regions of Azerbaidzhan). — In Sbornik: "Voprosy epidemiologii, bakteriologii, gigieny, parazitologii i virusologii," pp. 182—184. Synopses of Reports. Dushanbe. 1962.

Mirzoeva, N. M., V. I. Il'enko, K. A. Dyunina, and M. G. Akhundov. Dannye o serologicheskoi i virusologicheskoi razvedke arbovirusov v Kyzylagachskom zapovednike im. S. M. Kirova Azerbaidzhanskoi SSR (Data on the Serological and Virological Cultivation of Arboviruses in the Kirov Kyzyl-Aga Reserve in Azerbaidzhan). — In: Kleshchevoi entsefalit, Kemerovskaya kleshchevaya likhoradka, gemorragicheskie likhoradki i drugie arbovirusnye infektsii, pp. 205—206. Moskva. 1964.

Olsuf'ev, N. G. Novye eksperimental'nye dannye po voprosu o roli komarov v peredache i khranenii tulyaremiinoi infektsii (New Experimental Data on the Role of Mosquitoes in the Transmission and Preservation of Tularemia Infection). — Sbornik rabot, posvyashchennyi 30-letiyu nauchnoi deyatel'nosti akademika E. N. Pavlovskogo, pp. 176—189. Leningrad—Moskva. 1941a.

Olsuf'ev, N. G. Rol' komarov v peredache tulyaremiinoi infektsii dikim gryzunam, ptitsam i domashnim zhivotnym (The Role of Mosquitoes in the Transmission of Tularemia to Wild Rodents, Birds and Domestic Animals). — Ibid., pp. 190—197. 1941b.

Olsuf'ev, N. G. and D. A. Golov. Rol' komarov v peredache i khranenii tulyaremii (The Role of Mosquitoes in the Transmission and Preservation of Tularemia). — Trudy Otdela Parazitologii VIEM, Vol. 3: 213—246. 1938.

Olsuf'ev, N. G. and G. P. Rudnev (editors). Tulyaremiya (Tularemia). — Moskva, Medgiz. 1960. 459 pp.

Orekhov, M. D. Dipetalonematoz verblyudov v Turkmenskoi SSR i mery bor'by s nim (Dipetalonemiasis of Camels in Turkmenia and its Control). — Veterinariya, Vol. 4: 28—30. 1952.

Osipov, A. N. K vyyavleniyu promezhutochnykh khozyaev vozbuditelya setarioza krupnogo rogatogo skota v SSSR (On the Discovery of Intermediate Hosts of Setariasis of Cattle in the USSR). — Materialy k Nauchnoi Konferentsii Vsesoyuznogo Obshchestva Gel'mintologov, Vol. 4: 181—184. 1965.

Pavlovskii, E. N., A. K. Shtein, and P. P. Perfil'ev. Eksperimental'nye issledovaniya nad vliyaniem deistvuyushchikh nachal komara Culex pipiens na kozhu cheloveka (Experimental Study of the Effect of Active Principles of Culex pipiens on the Skin of Man). — DAN SSSR, A, Vol. 13: 251—254. 1928.

Petrishcheva, P. A. Komary — perenoschiki yaponskogo entsefalita v Yuzhnom Primor'e (Mosquitoes as Vectors of Japanese Encephalitis in the Southern Maritime Territory). — In: Parazitologiya Dal'nego Vostoka, pp. 106—143. Leningrad, Medgiz. 1947.

Řeháček, J. Kul'tivirovanie razlichnykh virusov v kleshchevykh tkanevykh kul'turakh (Cultivation of Viruses in Cultures of Tick Tissues). — Acta virol., Prague, 9 (4): 332—337. 1965.

Sazonova, O. N. Krovososushchie komary (Diptera, Culicinae) (Mosquitoes (Diptera, Culicinae)). — In: Perenoschiki vozbuditelei prirodno-ochagovykh boleznei, pp. 9—63. Moskva, Izd. "Meditsina." 1962.

Simanin, P. I. K voprosu ob eksperimental'nom zarazhenii komarov tropicheskoi malyariei (Experimental Infection of Mosquitoes with Tropical Malaria). — Parazitologicheskii Sbornik Zoologicheskogo Muzeya AN SSSR, pp. 37—44. 1930.

Simkova, A., V. Danielová, and V. Bárdoš. Eksperimental'nyi perenos virusa Ťahyňa komarami Aedes vexans (Experimental Transmission of Ťahyňa Virus by Aedes vexans). — Acta virol., Prague, 4 (6): 341—347. 1960.

Vigovskii, A. I. and A. V. Gutsevich. Predvaritel'nye rezul'taty izucheniya prirodnykh ochagov limfotsitarnogo khoriomeningita na zapade Ukrainy (Preliminary Results of the Study of Natural Foci of Lymphocytic Choriomeningitis in the Western Ukraine). — DAN SSSR, 140 (5): 1223—1225. 1961.

Publications in Other Languages

Bárdoš, V. and E. Čupková. The Čalovo Virus — the Second Virus Isolated from Mosquitoes in Czechoslovakia. — J. Hyg. (Prague), 6 (2): 186—192. 1962.

Bates, M. The Natural History of Mosquitoes. New York. 1962. 379 pp.

Chamberlain, R. W. and W. D. Sudia. Mechanism of Transmission of Viruses by Mosquitoes. — Ann. Rev. Entomol., Vol. 6: 371—390. 1961.

Committee of Experts on Malaria. 10th Report. — World Health Organisation, Ser. Tech. Rep., 272: 1—62. Geneva. 1965.

Contacos, P. G., J. S. Lunn, G. R. Coatney, J. W. Kilpatrick, and F. E. Jones. Quartan-Type Malaria Parasite of New World Monkeys Transmissible to Man. — Science, Vol. 142: 676. 1963.

Danielová, V. Experimentální studie vztahu viru Ťahyňa k některým druhům komárů. — Čslka. Epidem. Mikrobiol. Immunol., 11(3): 171—174. 1962.

Devine, T. L., C. E. Venard, and W. C. Myser. Measurement of Salivation by Aedes aegypti (L.) Feeding on a Living Host. — J. Insect Physiol., 11 (3): 347—353. 1965.

Edeson, J. F. B. and T. Wilson. The Epidemiology of Filariasis Due to Wuchereria bancrofti and Brugia malayi. — Ann. Rev. Entomol., Vol. 9: 245—268. 1964.

Ferreira, E. Distribuiçao geográfica dos anofelinos no Brazil e sua relação com o estado atual de erradicação de malária. — Revta. bras. Malar. Doenç. trop., 16 (3): 329—348. 1964.

Foote, R. H. and D. R. Cook. Mosquitoes of Medical Importance. — Agric. Handb. (U. S. Dept. Agric.), Vol. 152: 1—158. Washington. 1959.

Gordon Smith, C. E. Factors Influencing the Behavior of Viruses in their Arthropodan Hosts. "Host — Parasite Relationships in Invertebrate Hosts." Oxford. 1964. 31 pp.

Hannoun, C., R. Panthier, J. Mouchet, and J. P. Eouzan. Isolement en France du virus West-Nile à partir de malades et du vecteur Culex modestus Ficalbi. - C. r. hebd. Séanc. Acad. Sci., Paris, Vol. 259: 4170—4172. 1964.

Hawking, F. and M. J. Worms. Transmission of Filaroid Nematodes. — Ann. Rev. Entomol., Vol. 6: 413—432. 1961.

Hecht, O. Die Hautreaktionen auf Insektenstiche als allergische Erscheinungen. — Arch. Schiffs. - u. Tropenhyg., Vol. 33: 364—366. 1929.

Horsfall, W. R. Mosquitoes. Their Bionomics and Relation to Disease. New York. 1955. 723 pp.

Huff, C. G. Susceptibility of Mosquitoes to Avian Malaria. — Expl. Parasit., 16 (1): 107—132. 1965.

Jayewardene, L. G. Larval Development of Brugia ceylonensis Jayewardene, 1962, in Aedes aegypti, with a Brief Comparison of the Infective Larva with those of Brugia spp., Dirofilaria repens and Artionema digitata. — Ann. Trop. Med. Parasit., 57 (3): 359—370. 1963.

Jordan, H. B. Lizard Malaria in Georgia. — J. Protozool., 11 (4): 562—566. 1964.

Lavoipierre, M. M. J. Studies on the Host-Parasite Relationships of Filarial Nematodes and their Arthropod Hosts. II. The Arthropod as a Host to the Nematode: A Brief Appraisal of Our Present Knowledge Based on a Study of the More Important Literature from 1878 to 1957. — Ann. Trop. Med. Parasit., 52 (3): 326—345. 1958.

Mattingly, P. F. Ecological Aspects of the Evolution of Mosquito-Borne Virus Diseases. — Trans. R. Soc. Trop. Med. Hyg., 54 (2): 97—112; Discuss., pp. 130—134. 1960.

Mattingly, P. F. Some Considerations Relating to the Role of Culex pipiens fatigans Wiedemann in the Transmission of Human Filariasis. — Bull. Wld. Hlth. Org., Vol. 27: 569—578. 1962.

Mattingly, P. F. The Evolution of Parasite — Arthropod Vector Systems. — Evolution of Parasites, pp. 29—46. Oxford. 1965.

Mims, C. A., M. F. Day, and J. D. Marshall. Cytopathic Effect of Semliki Forest Virus in the Mosquito Aedes aegypti. — Am. J. Trop. Med. Hyg., 15 (5): 775—784. 1966.

Nelson, G. S. Factors Influencing the Development and Behavior of Filarial Nematodes in their Arthropodan Hosts. "Host-Parasite Relationships in Invertebrate Hosts," pp. 75—119. Oxford. 1964.

Pratt, H. D. Virus Diseases Transmitted by Mosquitoes and Other Arthropods. — Mosquito News, 24 (2): 91—103. 1964.

Raffaele, G. Adattamento allo sviluppo nel pollo di Plasmodium berghei. — Riv. Malar., 44 (1/3): 1—8. 1965.

Reeves, H. C. Mosquitoes and Virus Diseases. — Biological transmission of disease agents, pp. 75—82. New York. 1962.

Reeves, W. C. Ecology of Mosquitoes in Relation to Arboviruses. — Ann. Rev. Entomol., Vol. 10: 25—46. 1965.

Roy, D. N. Entomology (Medical and Veterinary). Calcutta. 1946. 358 pp.

Russell, P. F., L. S. West, and R. D. Manwell. Practical Malariology. Philadelphia. 1946. 684 pp.

Sandosham, A. A. Malariology with Special Reference to Malaya. Singapore. 1959. 327 pp.

Sérié, C., L. Andral, A. Lindres, and P. Neri. Epidémie de fièvre jaune en Ethiopie (1960—1962). — Bull. Wld. Hlth. Org., 30 (3): 299—319. 1964.

Singh, K. R. and Kh. M. Pavri. Isolation of Chittoor Virus from Mosquitoes and Demonstration of Serological Conversions in Sera of Domestic Animals at Manjri, Poona, India. — Indian J. Med. Res., 54 (3): 220—224. 1966.

Vincke, I. H. Le paludisme des rongeurs en Afrique. — Annls. Soc. belge Méd. trop., 44 (3): 579—586. 1964.

Viruses Transmitted by Arthropods. — World Health Organization, Ser. Tech. Rep., 219: 1—87. Geneva. 1962.

Warren, M., D. E. Eyles, R. H. Wharton, and C. K. Ow Yang. The Susceptibility of Malayan Anophelines to Plasmodium cynomolgi bastianellii. — Indian J. Malar., 17 (1): 85—105. 1963.

Webber, W. A. F. Dirofilaria aethiops Webber, 1955, a Filarial Parasite of Monkeys. III. The Larval Development in Mosquitoes. — Parasitology, Vol. 45: 388. 1955.

Wharton, R. H., D. E. Eyles, M. Warren, D. E. Moorhouse, and A. A. Sandosham. Investigations Leading to the Identification of Members of the Anopheles umbrosus Group as the Probable Vectors of Mouse Deer Malaria. — Bull. Wld. Hlth. Org., 29 (3): 357—374. 1963.

Wharton, R. H., D. E. Eyles, M. Warren, and W. H. Cheong. Studies to Determine the Vectors of Monkey Malaria in Malaya. — Ann. Trop. Med. Parasit., 58 (1): 56—77. 1964.

Yoeli, M. Studies on Plasmodium berghei in Nature and under Experimental Conditions. — Trans. R. Soc. Trop. Med. Hyg., 59 (3): 255—271; Discuss., pp. 272—276. 1965.

Yucel, A. and R. Deschiens. Dépistage d'un foyer de filariose à Wuchereria bancrofti en Turquie Orientale. — Bull. Soc. Path. exot., 53 (5): 885—891. 1960.

SYSTEMATIC PART

71 The family Culicidae was formerly considered to include the subfamilies Culicinae, Dixinae and Chaoborinae. They are at present considered as separate families of the Nematocera. Each family is distinctly characterized by important morphological characters of the adult insects and the larvae.

Family CULICIDAE

Mouth parts forming a proboscis several times longer than the width of the head (Figures 1, 2). Antennae with 15 segments, with dense, long hairs in the male and sparser, shorter hairs in the female. Wings narrow (Figure 6), veins with scales. Costa present at anterior and posterior margin of wing; subcosta long, extending to the costa; radius 4-branched, r_{2+3} forked, r_{4+5} simple; cross-vein between r_1 and r_2 absent; media with 3 branches; cross veins rm and mcu present; cu 1-branched;* anal vein long, extending to margin of wing.

The larvae differ markedly in external appearance. All thoracic segments fused, thorax broader than abdomen. Abdomen consisting of 9 segments, segment 8 formed by the fusion of segments 8 and 9; segment 9 is morphologically segment 10. There is a posterior pair of spiracles on the dorsal side of segment 8 or at the end of the siphon. Some larvae are predaceous but the antennae are not modified for capturing the prey. Vesicular widenings of the main tracheal trunks, if at all present, only in the thorax.

The family Culicidae is divided into three subfamilies: Anophelinae, Toxorhynchitinae and Culicinae. Each of the first two subfamilies is represented by a single species in the Palaearctic region and the diagnosis of the subfamily is therefore the same as that of the genus in the USSR (Anopheles Mg. and Toxorhynchites Theob. (Megarhinus Rob.-Des.)). They are included with the 6 genera of the subfamily Culicinae in the following key.

72 Key to genera

1 (2). Palps of female as long as the proboscis (Figure 28). Last two segments of the palps of the male club-shaped,(Figure 29). Abdomen usually without scales, or at least sternites without scales over a more or less large area . . . . 1. Anopheles Mg. (p. 78).

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* [Media 2-branched, cubitus 2-branched according to the usual interpretation.]

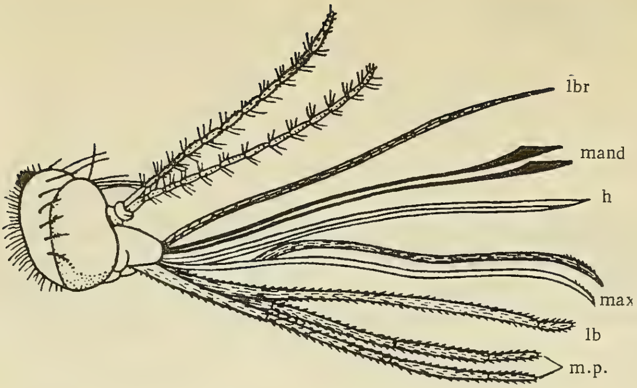

FIGURE 28. Mouth parts of the female of Anopheles:

lbr — labrum; mand — mandibles; h — hypopharynx; max — maxillae; lb — labium; m.p. — maxillary palps.

2 (1). Palps of female short, several times shorter than the proboscis (Figure 1). Last two segments of the palps of the male different. Tergites and sternites of abdomen covered with scales.

3 (4). Proboscis thick, distinctly tapering and curved ventrally in the apical half. Scutellum uniformly curved. Large mosquitoes, with tufts of bright hairs at the end of the abdomen

2. Toxorhynchites Theob. (p. 119).

(73)

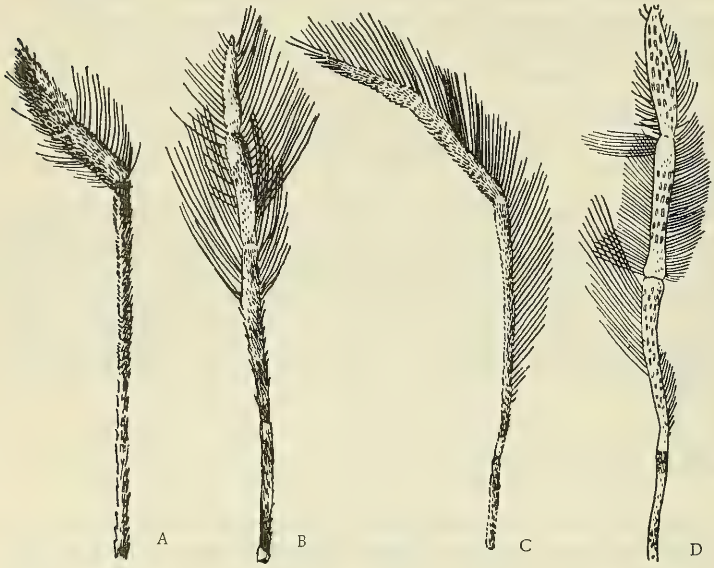

FIGURE 29. Palps of males (from E.N.Pavlovskii):

A — Anopheles; B — Aedes; C — Culex; D — Culiseta.

4 (3). Proboscis thin, more or less uniformly thick its entire length or slightly tapering and slightly curved in the apical part. Scutellum 3-lobed (Figure 30). (Subfamily Culicinae.)

(73)

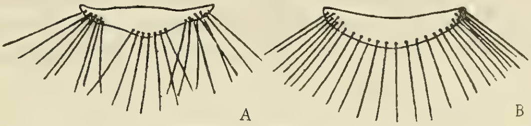

FIGURE 30. Scutellum:

A — Culicinae; B — Anophelinae.

5 (6). Anal vein ending in posterior margin of wing at level of branching of common stem of $r_{2+3} + r_{4+5}$ (Figure 31) ....
.... 3. Uranotaenia Arr. (p. 127).

(73)

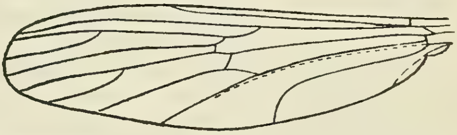

FIGURE 31. Wing of Uranotaenia

6 (5). Anal vein ending in posterior margin of wing at a more or less great distance beyond the point of branching of the common stem of $r_{2+3} + r_{4+5}$, near middle of wing.

7 (8). Spiracular setae present (Figure 4) ....
.... 5.Culiseta Felt (Theobaldia N.-Lem.) (p. 135).

8 (7). Spiracular setae absent (Figure 4).

9 (10). Postspiracular setae present. Claws of female usually with denticles. Cerci of female more or less projecting (Figure 11). .
.... 7. Aedes Mg. (p. 174).

10 (9). Postspiracular setae absent. Claws of female simple, without denticles. Cerci of females not projecting.

73 11 (12). First segment of fore tarsi longer than the next 4 tarsal segments together; 4th segment of fore tarsi reduced in both sexes .....
.... 4. Orthopodomyia Theob. (p. 131).

12 (11). First segment of fore tarsi not longer than next 4 tarsal segments together; 4th segment of fore tarsi of females not reduced.

13 (14). Pulvilli present (Figure 5). Wing scales narrow ....
.... 8. Culex L. (p. 338).

14 (13). Pulvilli absent. Wing scales usually broad ....
.... 6. Mansonia Blanch. (p. 167).

Remarks. Determination is facilitated by the fact that the 3 genera are represented by only one species in Russia. These species are distinguished by their characteristic color: Uranotaenia unguiculata: light blue lateral stripes on the thorax, Orthopodomyia pulchripalpis: narrow, white longitudinal stripes on a background of dark, brown scales on the mesonotum, and Toxorhynchites christophi: tufts of long, brightly colored hairs in posterior part of abdomen.

74 Males

The structure of the hypopygium of males is characteristic for each species; the generic differences are less distinct. The key to genera usually does not include the structure of the hypopygium. The present key is only provisional. The genus Toxorhynchites is omitted in the key because the hypopygium of T. christophi has not been described.

1 (2). Coxite without lobes. Style longer than coxite, rarely as long as coxite . . . . 1. Anopheles Mg.
2 (1). Coxite of most species (but not of all species) with 1 or 2 lobes. Style shorter than coxite, rarely nearly as long.
3 (4). Coxites situated close together. Coxite with one subapical lobe with spines and setae, rarely closely beyond the middle. Tenth sternite with numerous spines or a transverse row of denticles at the apex . . . . 8. Culex L.
4 (3). Coxites usually slightly separated. Coxite with 2 lobes (basal and apical), if with one lobe, it is situated at the base or in the middle of the coxite; lobe rarely absent. Tenth sternite without spines or a row of denticles at the apex (often with 1–3 large, sclerotized denticles).
5 (6). Apical appendage of style longer than width of style (Figure 7); if the appendage is not longer than the width of the style, the appendage is situated before the apex of the style; if an appendage is absent, the style is divided at the base . . . . 7. Aedes Mg.
6 (5). Appendage of style short, usually shorter than the width of the style.
7 (8). Lobe of coxite with one thick, strongly sclerotized, blunt spine (Figure 93) . . . . 6. Mansonia Blanch.
8 (7). Lobe of coxite, if present, at least with 2 pointed spines or strong setae.
9 (10). Coxite markedly thickened, short, with a small, flat lobe. Style broad, flattened (Figure 64) . . . . 3. Uranotaenia Arr.
10 (9). Coxite not markedly thickened, more or less oblong, with a conical lobe, rarely without such a lobe. Style narrow.
11 (12). Appendage of style about as long as the width of the style in its widest part (Figure 68). . . . . 4. Orthopodomyia Theob.
12 (11). Appendage shorter than the width of the style in its widest part (Figures 71 and 74); there may be 2 appendages at the apex of the style (C. longiareolata.) . . . . 5. Culiseta Felt.

Larvae

1 (2). Spiracles situated on dorsal side of 8th abdominal segment, surrounded by a stigmal plate (subfamily Anophelinae) . . . . Anopheles Mg. (p. 78).

2 (1). Spiracles and stigmal plate situated at end of siphon on dorsal side of 8th abdominal segment; siphon at least as long as wide at the base.

75 3 (4). Lateral lobes of labrum adapted to capture prey, each lobe with about 10 strong setae with curved and serrated end (subfamily Toxorhynchites Theob. (p. 118).

4 (3). Lateral lobes of labrum only rarely adapted to capture prey, each lobe with at least 30 hairs of different form (subfamily Culicinae).

5 (6). Siphon and valves of stigmal plate transformed into a piercing apparatus . . . . Mansonia Blanch. (p. 167).

6 (5). Siphon and valves of stigmal plate normal.

7 (14). Siphon with one pair of hair tufts on the posterior surface.

8 (9). Hair tufts situated at base of siphon . . . . . . Culiseta Felt (p. 135).

9 (8). Hair tufts situated in middle or near apex of siphon.

10 (11). Eighth abdominal segment with a chitinized plate at the sides with spines at the posterior margin. Denticles of pecten with fine spines at the margin . . . . Uranotaenia Arr. (p. 127).

11 (10). Only scales in one row or in a spot on sides of 8th abdominal segment. If a plate is present, the scales are isolated. Denticles of pecten, if present, with awl-shaped, pointed end.

12 (13). Pecten on siphon absent. On the dorsal side of abdominal segments 6–8 are chitinized plates which are larger on the posterior segments . . . . Orthopodomyia Theob. (p. 131).

13 (12). Pecten on siphon present. Plates on abdominal segments 6–8 absent . . . . Aedes Mg. (p. 174).

14 (7). Siphon with several pairs of hair tufts on the posterior and lateral surface . . . . Culex L. (p. 338).

I. Subfamily ANOPHELINAE

Clypeus usually longer than wide. Mandibles and maxillae of females well developed. Palps usually as long as proboscis in both sexes, rarely slightly shorter in females (in some exotic species). Mesonotum weakly convex; scutellum simple, curved (except in the tropical genus Chagasia). Legs very long and thin, with small, dense scales. Pulvilli absent. Wings relatively narrow, often with dark or light spots of scales; basal part of r_{4+5} extending slightly beyond cross-vein r-m toward base of wing, alula with narrow scales at the margin. Abdomen with hairs or rarely with hairs and scales. Hypopygium simple (Figure 9); coxite short, usually without basal lobe; at its position are spines or strong setae of varying number (1–6); anal segment completely membranous or weakly sclerotized; aedeagus simple, tubular, with or without terminal leaf-shaped appendages; females with one spermatheca.

The larvae have strongly developed lateral hairs on the body parallel to the surface of the water. A feathered type of branching is characteristic, a fanlike type absent. Head oblong. There are two pairs of clypeal
76 hairs at the anterior margin, outer and inner, and behind them a pair of postclypeal hairs. A row of 3 pairs of usually long, feathered hairs is situated behind the antennae on the frontoclypeus. There are 2 pairs of frontal hairs in the larvae of the tropical genus Chagasia. Antennae short, rod-shaped, with a branched, rarely simple hair, and two large, flattened spines and sensory hairs at the end. Because of feeding at the surface of the water, the head can be rotated through 180° toward both sides, so that the ventral side is upward. At the sides of the anterior margin of the thorax are two-lobed shoulder organs which can be retracted and hold the larvae at the surface film. The hairs on the thorax are arranged in three bands corresponding to the thoracic segments, with 13–14 pairs of hairs in each band. The abdomen bears characteristic palmate hairs, one pair on the 7 anterior segments. These hairs may be rudimentary on segments 1–3. The palmate hairs and shoulder organs attach the larvae to the surface film. The spiracles are situated on the dorsal side of the 8th abdominal segment and are surrounded by the stigmal plate. This is supported by two lateral plates with a comb of spines which are connected posteriorly by a chitinized arc.

The pupae have short, broadly open respiratory funnels; the lateral hairs of the abdominal segments are situated at the anterior lateral corner of the segment. Caudal paddles with 2 hairs, one at the apex of the medial rib, the other, smaller hair, anterior to it.

Eggs usually with a fringe and air floats.

The subfamily contains three genera. Only species of the main genus Anopheles are represented in the Palaearctic.

1. Genus Anopheles Meigen

With the characters of the subfamily; scutellum curved; stem of medial fork $m_1 + m_2$ straight. The larvae of Palaearctic species of Anopheles are divided into three groups: 1) all species of the subgenus Anopheles, 2) A. (A.) plumbeus and 3) species of the subgenus Myzomyia. The characters of these groups are given in the key. The genus Anopheles is divided into six subgenera of which four are mainly neotropical. Species of the subgenera Anopheles Mg. and Myzomyia Blanch. (Cellia Theob.) are represented in the Palaearctic region.

Key to Species

Females

1 (14). Cross-veins and base of forms $r_2 + r_3$, $m_1 + m_2$ and $m_{3+4} + cu_1$ covered with dark scales; costa with uniformly dark scales or with one or two light spots at the anterior margin. (Subgenus Anopheles Mg.)

2 (11). Wings with dark scales (yellowish-brown or brown), often with denser spots of darker scales but without spots of white scales; fore femora thin, cylindrical.

3 (10). Wings with more or less uniformly colored scales, without spots
77 of darker scales; base of anterior fork of wing (r_{2+3}) usually situated slightly closer to base of wing than base of medial fork (m_1+m_2).

4 (5). Tuft of narrow, white scales absent on the vertex. Mesonotum uniformly brownish-yellow, with moderately long, dark brown hairs . . . . 1. A. (A.) algeriensis Theob.

5 (4). White tuft on vertex distinct. Lateral parts dark; hairs on mesonotum light in some parts.

6 (7). Apex of proboscis whitish . . . . 4. A. (A.) marteri Sen.-Prun.

a (b). Fringe of wing white at the apex . . . . A. (A.) marteri marteri Sen.-Prun.

b (a). Fringe of wing dark at the apex . . . A. (A.) marteri sogdianus Kesh.

7 (6). Proboscis dark at the apex.

8 (9). Smaller and darker; body mainly blackish-gray with a leaden tinge. Tuft of scales at anterior margin of mesonotum distinct, white . . . . 2. A. (A.) plumbeus Steph.

9 (8). Larger and paler; body mainly yellowish brown or brown. Tuft of scales at anterior margin of mesonotum more weakly developed and with a yellowish tinge . . . . 3. A. (A.) claviger Mg.

10 (3). Wings with spots formed by groups of darker scales; base of forks of vein r_{2+3} and vein m_{1+2} situated at the same distance from base of wing . . . . 5. A. (A.) maculipennis Mg.

a (b). Body dark brown; mesonotum with a broad, gray median longitudinal stripe and dark brown lateral parts; dark spots on wings distinct . . . . A. (A.) maculipennis maculipennis Mg.
A. (A.) maculipennis messeae Fall.
A. (A.) maculipennis melanoon Hack.
A. (A.) maculipennis labranchiae Fall.
A. (A.) maculipennis atroparvus van Thiel.

b (a). Body pale yellowish brown; mesonotum more or less pale brown; dark spots on wings weak, especially in males . . . . A. (A.) maculipennis sacharovi Favre.

11 (2). Wings with white spots at anterior margin formed by white scales or with one white spot; fore femora thickened at the base.

12 (13). Costa with one white spot near the apex. Hind femora with distinct, subapical white ring. Fore femora slightly thickened at the base . . . . 6. A. (A.) lindesayi Giles.

a (b). White scales on lower surface of hind femora present in $^1/_3$ of length of femur from the base. . . A. (A.) lindesayi lindesayi Giles.

b (a). White scales on lower surface of hind femora present only in $^1/_6$ of length of femur from the base . . . A. (A.) lindesayi japonicus Yam.

78 13 (12). Costa with 2 pale spots. Hind femora without white, subapical ring. Fore femora distinctly thickened at the base . . . . 7. A. (A.) hyrcanus Pall.

14 (1). Cross-veins and base of forks r_{2+3} and m_{1+2} with white scales; costa with four or more light spots at the anterior margin. (Subgenus Myzomyia Blanch.).

15 (16). Abdomen covered with scales on both sides, forming projecting tufts. Fifth segment of hind tarsi white. Palps of females with upright scales in basal part . . . . 8. A. (M.) pulcherrimus Theob.

16 (15). Abdomen with hairs, without scales. Fifth segment of hind tarsi dark. Palps of females with adpressed scales . . . . 9. A. (M.) superpictus Grassi.

Males

1 (14). Coxite with 2 (rarely 1 or 3) large setae on inner side of base, at least one of them situated on a teat-shaped tubercle. (Subgenus Anopheles Mg.)

2 (3). Coxite with one thick spine on inner side of base . . . . 1. A. (A.) algeriensis Theob.

3 (2). Coxite with 2–3 large setae on inner side of base.

4 (5). Coxite with 3 large setae, 2 of them branched, on inner side of base . . . . 3. A. (A.) claviger Mg.

5 (4). Coxite with 2 simple (not branched) strong setae on inner side of base.

6 (9). Setae (spines) of claspettes situated close together but not fused.

7 (8). Aedeagus short and broad, without leaf-shaped appendages at the apex . . . . 2. A. (A.) plumbeus Steph.

8 (7). Aedeagus long and narrow, with leaf-shaped appendages at the apex . . . . 5. A. (A.) maculipennis Mg.

9 (6). At least some setae (spines) of claspettes fused, forming a transparent plate.

10 (13). Lobes of tergite 9 conical or trapezoidal, short (not high), about as high as wide.

11 (12). Coxite with thick setae near middle of inner margin. (Wings with uniformly dark scales) . . . . 4. A. (A.) marteri Sen.-Prun.

12 (11). Coxite with a relatively thin seta near middle of inner margin. (Wings with spots of white scales) . . . . 6. A. (A.) lindesayi Giles.

13 (10). Lobes of tergite 9 long, 3–4 times longer (higher) than wide . . . . 7. A. (A.) hyrcanus Pall.

14 (1). Coxite with 4–6 large setae on inner side of base, situated directly on surface of coxite, not on a tubercle. (Subgenus Myzomyia Blanch.)

15 (16). Aedeagus with short, leaf-shaped appendages at the apex . . . . 9. A. (M.) superpictus Grassi.

16 (15). Aedeagus without leaf-shaped appendages at the apex . . . . 8. A. (M.) pulcherrimus Theob.

79 *4th-stage larvae*

1 (2). Frontal hairs short, simple. Lateral hairs on abdominal segments 4–6 long, distinctly feathered . . . . 2. A. (A.) plumbeus Steph.

2 (1). Frontal hairs long, feathered. Lateral hairs on abdominal segments 4–6 not feathered, divided into a few branches from near the base.

3 (16). Inner clypeal hairs situated close together.

4 (11). Outer clypeal hairs simple or slightly branched at the end or from the middle.

5 (6). Clypeal hairs with fine secondary feathering from the middle or last third. Leaflets of palmate hairs long and narrow. Comb at sides of base of stigma plate with 20–25 teeth . . . . 1. A. (A.) algeriensis Theob.

6 (5). Clypeal hairs smooth, without fine secondary feathering.

7 (8). Postclypeal hairs with 2–5 branches. Leaflets of palmate hairs without terminal filaments, broad, deeply denticulate at the lateral margins. Spiracles not connected with central plate. Comb at sides of base of stigmal plate with 12–16 teeth . . . . 3. A. (A.) claviger Meig.

8 (7). Postclypeal hairs simple. Spiracles connected with central plate, often by a special process.

9 (10). Palmate hairs on metathorax weakly developed, with 10–11 leaflets. Palmate hairs of abdomen ending in a long filament . . . . 4. A. (A.) **marteri** Sen.-Prun.

10 (9). These palmate hairs well developed, with 15–20 leaflets which become gradually pointed, without a long terminal filament . . . . 6. A. (A.) lindesayi Giles.

11 (4). Outer clypeal hairs branched, dendriform.

12 (13). Antennal hair long, about half as long as antenna, situated in its middle or slightly proximal to middle . . . 7. A. (A.) hyrcanus Pall.

13 (12). Antennal hair very short, not longer than the width of the antenna, situated nearer to the base.

14 (15). Outer clypeal hairs reaching to anterior margin of lateral lobes of labrum or beyond. Stigmal plate smaller (0.38–0.50 mm long, width between ends of lateral lobes 0.39–0.52 mm), slightly pigmented; middle of posterior part of central plate pale, alveoli and folds of anterior part weakly developed . . . . A. (A.) maculipennis sacharovi Favre.

15 (14). Outer clypeal hairs different. Stigmal plate large (0.50–0.57 mm long, width between ends of lateral lobes 0.56–0.59 mm), darkly pigmented. Middle of anterior part of central plate, alveoli and folds of anterior part dark, distinct. . 5. A. (A.) maculipennis Meig.

16 (3). Inner clypeal hairs widely separated.

17 (8). Outer clypeal hairs finely branched, with 6–15 branches. Post-
80 clypeal hairs with 2–4 branches, rarely simple. Central plate of
stigmal plate distinctly tapering in anterior part of median part,
its middle weakly pigmented with distinct outline. Anterior part
of central plate in the form of an arrow-head, its lateral pro-
cesses oblong, processes to spiracles absent . . . .
. . . . 8. A. (M.) pulcherrimus Theob.

18 (17). Outer clypeal and postclypeal hairs simple. Central plate broad, not tapering in anterior part of median part; sharp outline in median part absent. Anterior part of central plate without lateral

processes, processes to spiracles present, rarely absent . . . . . .
. . . . 9. A. (M.) superpictus Grassi.

1. Subgenus Anopheles Meigen

Cross-veins and base of forks r_{2+3} and m_{1+2} + m_3 with dark scales; costa usually with 1–2 light spots or without spots. Coxite with 2 (rarely 1 or 3) large setae on inner side of base, at least one of them situated on a teat-shaped tubercle.

Larvae of the subgenus Anopheles, except A. plumbeus, with inner clypeal hairs situated close together, with large, feathered frontal hairs, a branched hair on the antenna, and long lateral hairs (No. 6) on abdominal segments 4–5, branching from near the base into 2–5 branches, and short branches on segment 6. The larvae of A. plumbeus have more widely separated inner clypeal hairs, short simple frontal hairs, a simple hair on the antennae and long, feathered hairs on abdominal segments 4–6.

The subgenus Anopheles is widely distributed (more than 100 species, 10 species in the Palaearctic region). The species occur in all zoogeographical regions. The Palaearctic species of Anopheles form two groups according to their distribution: the group related to A. maculipennis is mainly distributed in the temperate zone, far to the north; 2) the other group, related to A. hyrcanus, is mainly distributed in the Oriental region and is represented by a number of species. It does not extend so far north.

1. Anopheles (Anopheles) algeriensis Theobald, 1903

This species differs from the other species of the genus in the absence of spots on the wings and the tuft of white scales on the vertex. Thorax and abdomen mainly pale brown; mesonotum with dark hairs. Hind tarsi sometimes with indistinct, pale rings.

Hypopygium (Figure 32) very characteristic: at the base of the coxite is a large spine situated on a distinct tubercle. The outer spines of the basal part of the coxite, which are present in A. claviger, are 1–2 not constant, weak setae. Near the apex of the inner side of the coxite is a
81 large seta. Claspettes 3-lobed, outer lobe with 2–3 large, pointed spines situated close together, median lobe covered with hairs, inner lobe with 3 more or less equal setae. Aedaegus with 2–3 pairs of long, thin, leaf-shaped appendages at the apex.

The 4th-stage larva (Figure 33) resembles that of A. claviger. Head: inner clypeal hairs long, simple, situated close together or rarely slightly branched at the ends, with thin secondary feathering which begins from the middle or near the apex; outer clypeal hairs half as long as inner hairs, also with secondary feathering, simple or with 2–3 branches at the ends. Postclypeal hairs smooth, simple, rarely 2-branched at the end, usually reaching to the base of the anterior clypeal hairs. Antennae dark, with more numerous, dark spines than in A. claviger.

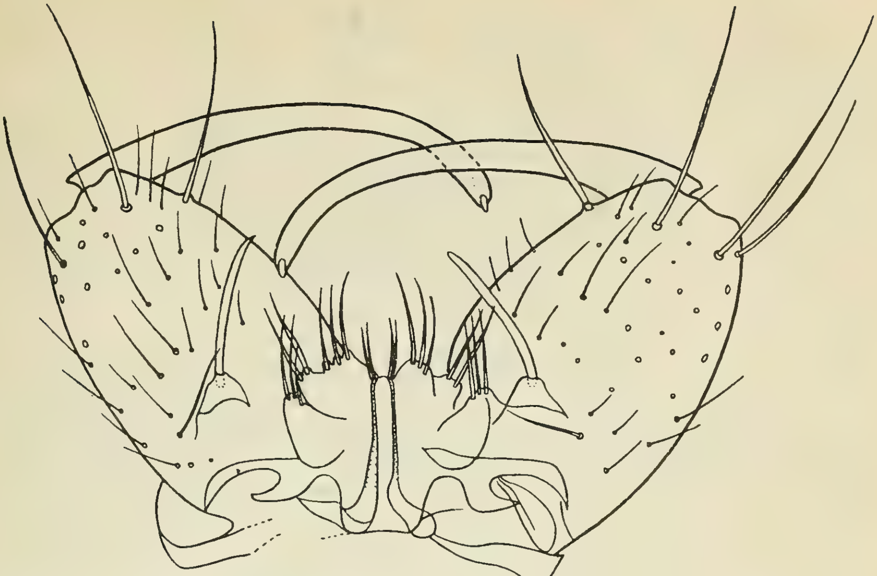

FIGURE 32. Hypopygium of Anopheles algeriensis Theob.

(82)

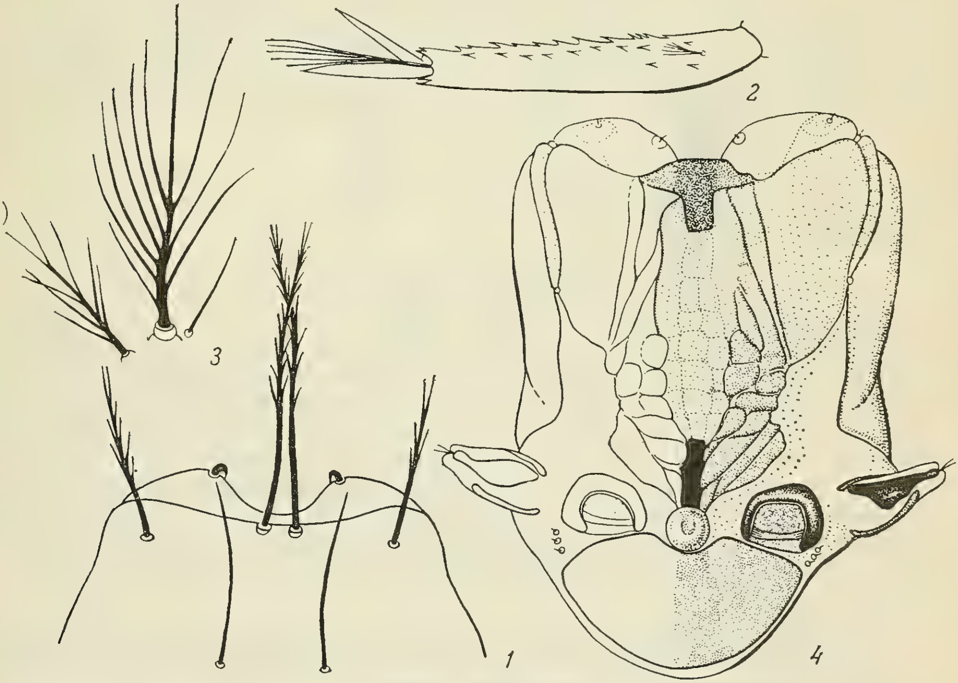

FIGURE 33. Anopheles algeriensis Theob. Fourth-stage larva:

1 – anterior part of frontoclypeus; 2 – left antenna; 3 – median hairs of prothorax (right side); 4 – stigmal plate.

The palmate hairs of abdominal segments 3–7 consist of 16–18 slightly pigmented, lanceolate leaflets with a weakly developed terminal filament and distinctly denticulate margin.

Stigmal plate not pigmented, without distinct alveoli in the middle of the central plate, its median part not different from the lateral parts. The median part is even usually lighter than the surrounding parts. The anterior process usually does not extend posteriorly beyond the anterior and median part of the central plate. The comb on the 8th abdominal segment has 7–11 large teeth (the marginal teeth are the longest) and there are 1–3 small spines between them. The spines bear a row of small spines at the base of the apical margin.

Eggs oblong-oval, markedly widened in the middle and with distinct air floats but without a fringe.

82 Distribution. Mainly in the Mediterranean to England in the north. The discovery of A. algeriensis on Sarema Island at the west coast of Estonia is interesting (Remm, 1957). In the USSR it occurs in Transcaucasia, the Northern Caucasus and in Middle Asia. It is usually rare. A mass appearance has been observed in the lower reaches of rivers, e.g. in the lower reaches of the Sulak River in Dagestan (Enikolopov, 1937).

Biology. The larvae are found in large swamps densely overgrown with vegetation (a typical submerged plant in such water bodies is Hippuris vulgaris) in small, well shaded water bodies, mainly in stagnant, markedly saline water. In Tadzhikistan (Glagoleva, 1944), the larvae are found only in springs in swamps with hard, alkaline water. The larvae often occur together with larvae of A. hyrcanus and Culex territans. They hibernate. The mosquitoes attack man and animals. In Middle Asia (Tadzhikistan) they appear mainly in spring and autumn. The mosquitoes are usually found in thickets of bulrushes; they rarely enter stables and still more rarely human habitations.

2. Anopheles (Anopheles) plumbeus Stephens, 1828
(nigripes Staeger, 1839)

Distinguished by its dark color and slightly smaller size than A. claviger.

83 Occiput with black scales laterally, with a tuft of narrow, white scales on the vertex, which is directed anteriorly. Proboscis and palps black. Thorax blackish-brown; mesonotum with a broad, median longitudinal stripe $^{1}/_{3}$ as wide as the mesonotum; a tuft of narrow white scales in middle of anterior margin of mesonotum; lateral parts of mesonotum and sides of thorax blackish-brown; scutellum blackish. Legs black or blackish-brown, coxae and base of femora pale. Wings without spots, densely covered with dark brown scales; halteres with black head. Abdomen black, shiny dorsally, slightly paler ventrally. Hairs of thorax and abdomen pale brown with a golden tinge.

Hypopygium (Figure 34): coxite with 2 strong, simple setae at the base; a large seta near middle of inner side of coxite; spines at apex of claspettes situated close together but not fused; aedeagus short, broad, without appendages.

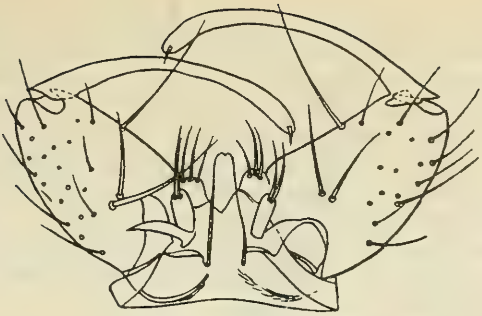

FIGURE 34. Hypopygium of Anopheles plumbeus Steph.

Fourth-stage larva (Figure 35): dark gray to dark brown. In recently molted specimens, the abdomen is ringed because the pigmentation between the segments is weak.

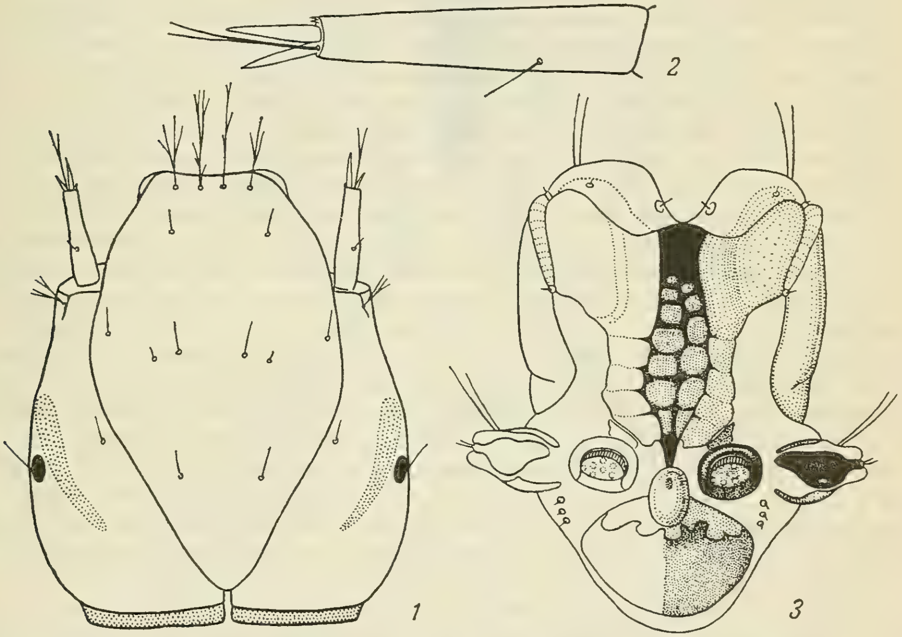

FIGURE 35. Anopheles plumbeus Steph. Fourth-stage larva:
1 — head, dorsal; 2 — left antenna; 3 — stigmal plate.

84 Head uniformly dark brown, with weakly developed compound eyes. Clypeal hairs thin, slightly branched at the ends. They are simple, smooth and unbranched in larvae of A. plumbeus var. barianensis. The hairs are situated at about the same distance from each other. Postclypeal

hairs, frontal and other hairs thin, short and simple. Antennae dark, straight, without spines, with a short, simple hair near the base. Abdomen: palmate hairs present on segments 2–7, short and simple on 1st segment; with about 15 leaflets of uniform color, lanceolate, with pointed end but without terminal filament; their margin may be slightly denticulate from $^{1}/_{3}$ from the base. Lateral hairs on abdominal segments 4–6 long and feathered. Stigmal plate with dark anterior lobe. Spiracles connected by a process, rarely directly connected with anterior part of central plate. This has the form of an onion, with a narrow dark anterior process. The granulation of the median part of the central plate is dark and sharply defined from the lighter lateral parts.

Eggs oblong-oval, with a wide fringe but without air floats.

Distribution. It is mainly distributed in the Mediterranean; in Western Europe to England and southern Sweden in the north and to Estonia in the USSR (Remm, 1957). It occurs in the Ukraine (rare), Northern Caucasus, Transcaucasia, Turkmenia (forests of Kopet-Dagh) and Tadzhikistan.

The Anopheles in India and Pakistan is considered by most authors as the species A. barianensis James, 1911, but there are no distinct differences between A. plumbeus and A. barianensis. The adults and larvae from Tadzhikistan examined are typical A. plumbeus.

In the southern parts of its range the species occurs only in broadleaved forests in mountains and valleys to an altitude of 1,600–2,000 m.

Biology. The larvae live in water in tree holes (of birch, elm, oak, ash in the Ukraine; hornbeam, oak, chestnut, maple, walnut, ash and fruit trees in the Crimea; beech, oak, chestnut, maple, walnut, Tartar maple, Oriental plane, maple, apple in the Caucasus; walnut, mulberry, Oriental plane tree in Tadzhikistan), mainly in shaded areas. Larvae were found in Abkhazia in shaded, artificial water bodies (abandoned pits, basins of sewage systems, etc.). They were found together with larvae of Aedes geniculatus, A. pulchritarsis, Orthopodomyia pulchripalpis, and also with larvae of Myiatropa florea L. (Syrphidae). The water in the breeding places of A. plumbeus, according to studies in Tadzhikistan (Glagoleva, 1946), is distinctly alkaline, with a high concentration of salts of alkaline metals (mainly potassium and sodium), in addition to humic and ulmic acid, tannin, pigments, etc. extracted from the tree holes; the water is brown. The eggs and larvae of all stages hibernate. They
85 survive freezing of the water and the eggs are able to withstand long periods of frost. This is a typical forest insect which rarely enters buildings or bites man.

Plasmodia of malaria may complete a cycle of sporogony, but the importance of this species as a vector is very small because of its ecology. It was of epidemiological importance in the past in forests in Caucasian resorts.

86 3. Anopheles (Anopheles) claviger Meigen, 1804
(bifurcatus auct.)* (Figure 36)

Yellowish brown in its greater part. Head with narrow dark brown scales laterally, with narrow white scales on the occiput. Vertex with an

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* Linnaeus described the male of Culex pipiens as "Culex bifurcatus." The name Anopheles bifurcatus L. should therefore be replaced with A. claviger Mg.

(85)

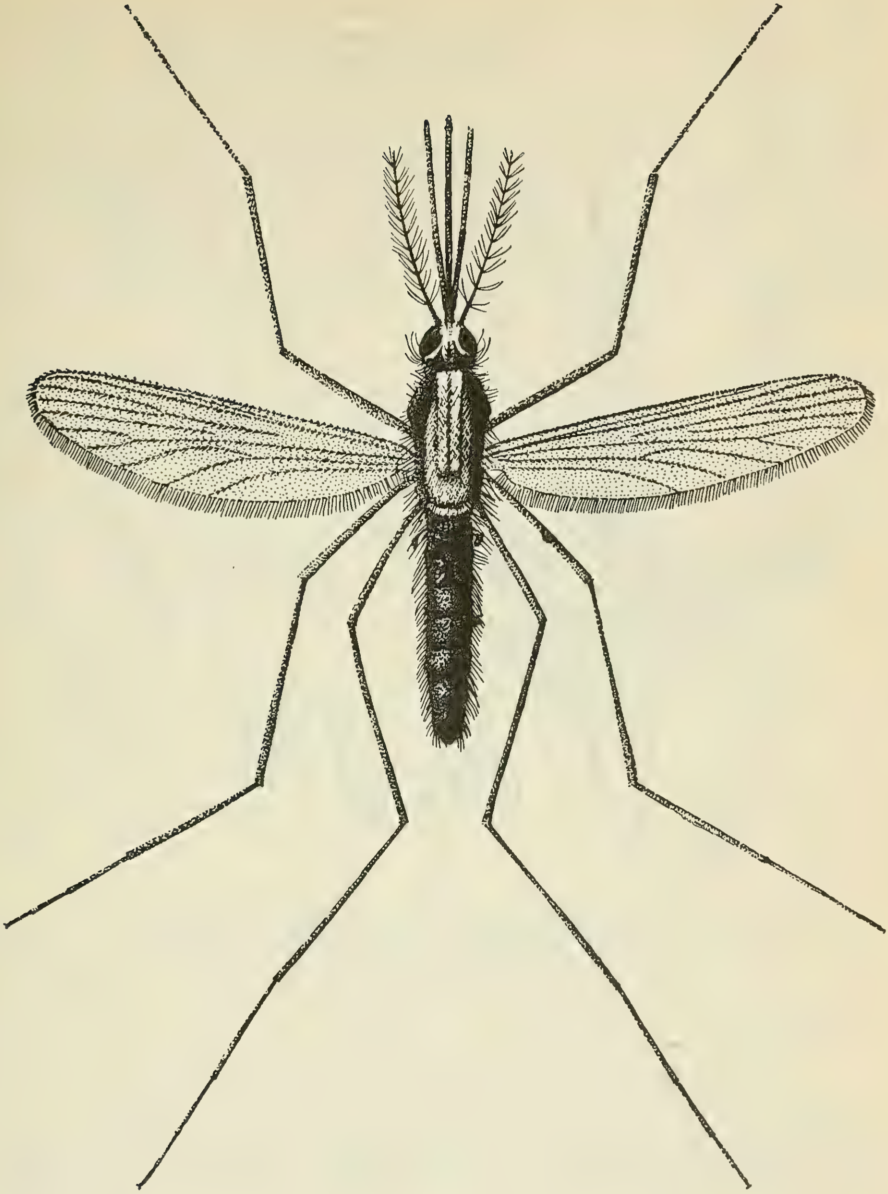


FIGURE 36. Anopheles claviger Mg.

anteriorly directed tuft of cream-colored scales and hairs; proboscis and palps uniformly dark brown; antennae brown, basal segments lighter; hair on the antennae branched. Mesonotum brown, with a broad, median, anteriorly tapering, whitish gray stripe about $^3/_5$ as wide as the mesonotum, with a tuft of yellowish white scales in the middle anteriorly; hairs on mesonotum whitish yellow in the middle, brownish laterally; scutellum brown, often pale brown, with brownish setae at the posterior margin; pleurae of thorax brown, with weak tomentum. Legs brown or dark brown, paler on ventral side of femora and tibiae, and at the articulations; tarsi dark brown. Wings transparent, veins with brown scales; halteres with dark brown head. Abdomen brown, darker at posterior margin of tergites, with long, pale brown hairs.

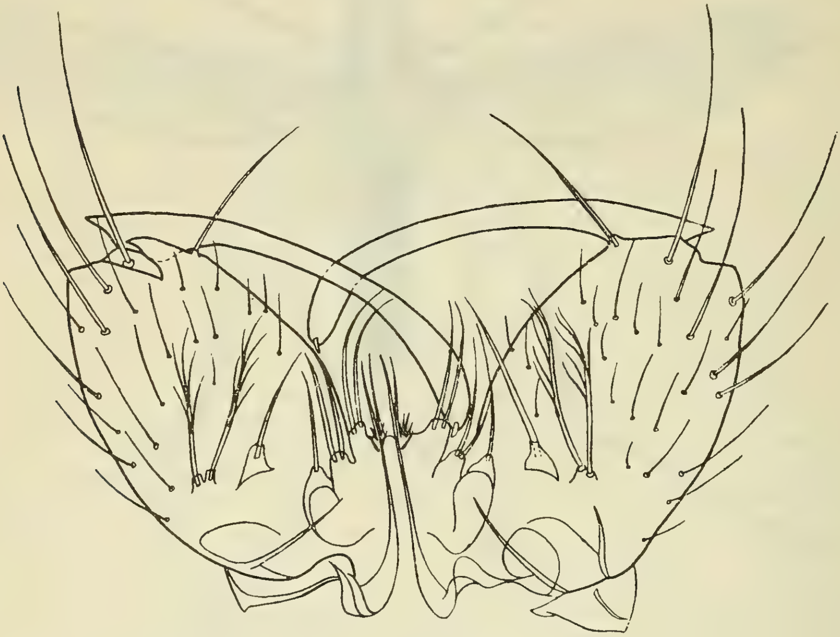


FIGURE 37. Hypopygium of Anopheles claviger Mg.

Hypopygium (Figure 37) with one strong seta near the apex on the inner side of the coxite. Three large strong setae at base of coxite, the outer 2 setae situated close together and branched in their apical half; inner seta
87 simple, situated on a tubercle.

Fourth-stage larva (Figure 38) large and dark, with strongly pigmented head and stigmal plate.

Inner clypeal hairs long, nearly as long as the antenna, simple or with 2–4 branches at the apex, without secondary feathering, situated close together. Outer clypeal hairs shorter than inner hairs, smooth, rarely simple, often with 2–4 branches from the middle or in the last third.

Postclypeal hairs short, thin, with 2–5 branches nearly from the base. Antenna half as long as the head, with sparse spines on the inside, hair short, with 4–7 branches, situated near the base.

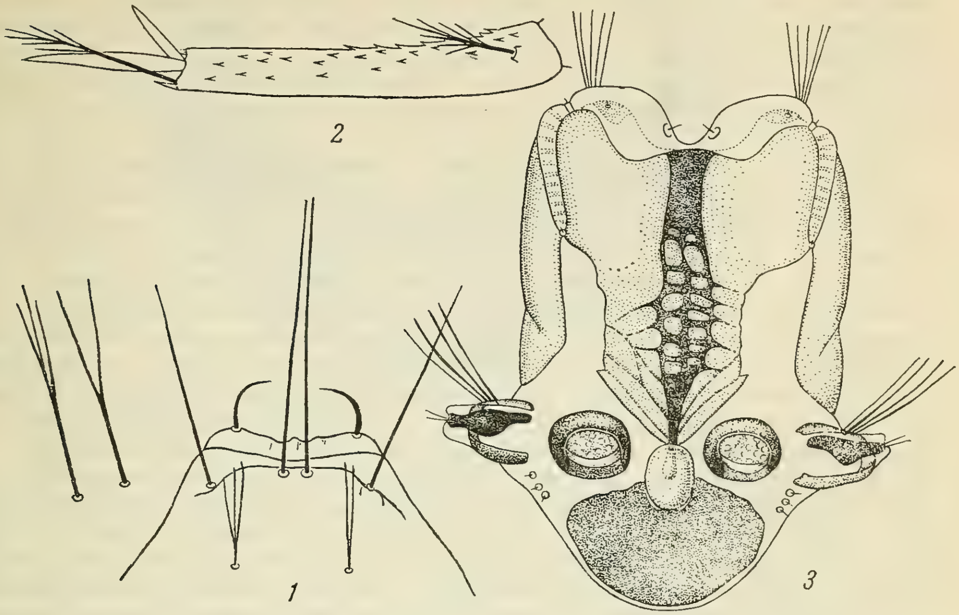


FIGURE 38. Anopheles claviger Mg. Fourth-stage larva:

1 – anterior part of frontoclypeus (outer clypeal hair branched at the end at left); 2— left antenna; 3 – stigmal plate.

Palmate hairs well developed on abdominal segments 3–7; leaflets lanceolate, with slightly elongate apex, but without terminal filament, with smooth or slightly denticulate, weakly but uniformly pigmented. Lateral hairs of segments 1–3 feathered, branched on segments 4–6.

Stigmal plate with entirely dark anterior lobe, without connection with the spiracles in anterior part of central plate, triangular with the apex anteriorly and distinctly pigmented in the middle, entirely dark in the anterior and posterior parts and alveolate, with dark outline in the median part. The stigmal plate of 2nd- and 3rd-stage larvae of A. algeriensis and A. hyrcanus and of 2nd-stage A. maculipennis is similar.

Comb on 8th abdominal segment with 12–14 large and medium-sized spines alternating with smaller spines.

88 Eggs oblong-oval, with a large number of air floats and a simple fringe, not transversely striated, present only at the ends of the egg.

Note on systematics. Several subspecies of A. claviger have been described; one of them in the Mediterranean, A. petragnani Del Vecchio, 1939, should be considered as a distinct species. It differs in details of the chaetotaxy of the larva, and in the structure of the egg and pupa.

A. claviger and A. petragnani do not cross or produce viable offspring but further information is necessary to determine the status of A. petragnani.

Distribution. European USSR to the Leningrad Region (60°N). Widespread in the Crimea and Caucasus (Northern Caucasus, Dagestan, Georgia, Armenia, Azerbaidzhan); Middle Asia (Turkmenia, Uzbekistan, Tadzhikistan, Kirghizia); to 2,000 m altitude in mountains of Middle Asia; Kazakhstan, and West Siberia to Tomsk in the east. Europe, from central Sweden and Norway to Italy; Southwest Asia (Palestine, Asia Minor, Iraq, Iran); North Africa.

Biology. The larvae breed in water slightly warmed by the sun, in moderately or weakly mineralized water fed by springs, in stagnant (swamps) and flowing water, shaded by trees, shrubs, rocks, etc. They breed in the mountains in backwaters of streams or in springs, in irrigation canals fed by springs. In some mountainous and foothill localities, they are sometimes found in or around populated areas. The mosquitoes often enter houses and stables. Larvae of the 3rd and 4th stage hibernate in water that does not freeze at the bottom. In southern parts of their area of distribution their development does not cease in winter but it becomes very slow. The larvae are very agile and descend to the bottom at the slightest disturbance. The adults spend their days among plants and enter buildings in spring. They usually bite in the open air. The females of some populations of A. claviger may have an autogenous first batch of eggs without sucking blood (Markovich, 1941).

A. claviger is a potential vector of malaria of man. Its epidemiological importance in most of its range is not large, but in localities where the larvae breed in populated areas it may be an important carrier. Natural infection of A. claviger with tularemia has been established.

4. Anopheles (Anopheles) marteri Senevet and Prunelle, 1927

This species resembles A. claviger, but differs from it in the whitish apex of the proboscis (female) and in the hypopygium, which has two strong, simple, not feathered setae at the base of the coxite. The structure of the hypopygium resembles that of A. maculipennis but differs in the appendages of the claspettes, which form narrow plates. There are only setae on the claspettes in A. maculipennis or the setae are fused into a narrow plate only in the dorsal part of the claspettes.

Occiput with whitish scales in the anterior part; long, hairlike scales
89 between the eyes. Proboscis with whitish apex, without pale rings; white scales at the base of the palps. Palps of male about as long as proboscis. Mesonotum with a whitish median stripe only in its anterior part ($^1/_2 - {}^1/_3$) and two dark stripes laterally, with numerous narrow, brown or golden scales which are lighter and wider on the median longitudinal stripe. The dark stripes of the mesonotum are without scales or hairs in the anterior part. Scutellum with longer setae in the lateral parts. Legs: coxae yellowish white with pale yellow hairs; femora, tibiae and tarsi blackish brown with a bluish tinge; tarsi without rings. Wings without spots, with dense, dark scales; fringe at apex of wing white.

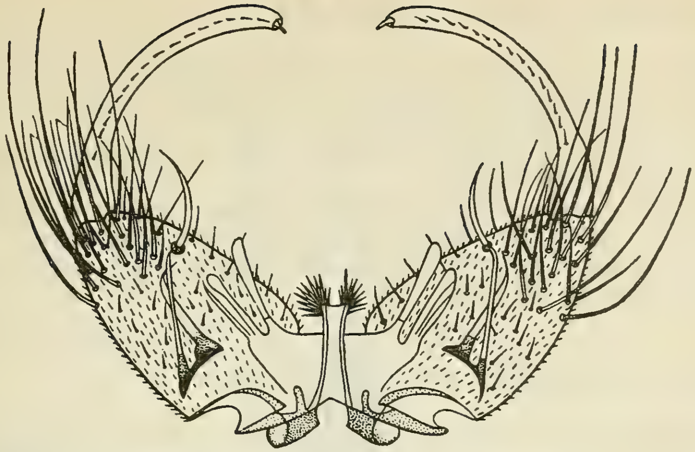


FIGURE 39. Hypopygium of *Anopheles marteri* Sen.-Prun.

Hypopygium (Figure 39): coxite with 2 strong, spinelike setae in the basal part, medium seta thick, curved at the end and one strong seta in the apical third of the inner side and numerous small hairs on the dorsal surface. Claspettes with 2 lobes which are sometimes indistinctly divided. Dorsal lobe of claspettes with 3 narrow, plate-shaped processes. Ventral lobe with a plate which is wider toward the apex. Aedeagus with long, leaf-shaped appendages.

Fourth-stage larva resembling that of *A. lindesayi*. Clypeal hairs simple, inner hairs situated close together, more than twice as long as the outer hairs; clypeal hairs as long as outer clypeal hairs or longer. Frontal hairs feathered, with 6–7 pairs of lateral branches, slightly shorter than the inner clypeal hairs; ends of inner frontal hairs hardly reaching base of postclypeal hairs. Antennae with dark apex in $^1/_5$ of their length. Hair of antenna with 3–4 moderately long branches near the middle, slightly proximal to it.

Hair No. 1 on metathorax forming a palmate hair with 10–11 leaflets which are wider at the base and taper apically with sharp steps to a terminal filament. Palmate hairs well developed on abdominal segments 2–7, with 15–19 elongate, narrow leaflets. They pass from the middle in 2–3 irregular steps into the terminal filament, which is $^1/_3$ as long as the leaflet.

90 Stigmal plate with an anterior lobe which is darkly pigmented at the base and lighter at the anterior margin; spiracles connected with anterior part of central plate by processes. Central plate very broad in the middle, granulation in middle lighter.

Distribution. Mediterranean: Corsica, Balkans, Algeria, Palestine. The subspecies *A. marteri sogdianus* Kesh. occurs in Middle Asia and Northern Iran. The species occurs in the USSR only in the mountains of Tadzhikistan (Keshish'yan, 1938).

Anopheles marteri sogdianus Keshishian, 1938

It differs from the nominate subspecies in the absence of a white spot at the apex of the fringe of the wing. It was at first described as a distinct species from Tadzhikistan (Keshish'yan, 1938).

Distribution. USSR: mountain regions of Tadzhikistan at altitudes above 1,000 m. Northwest Iran.

Biology. Larvae are found in large numbers in spring (April–June) in shaded rock pools in mountain rivers, streams and springs, often together with larvae of A. claviger and A. lindesayi. Its ecology resembles that of larvae of A. marteri.

5. Anopheles maculipennis Meigen, 1818 (Figure 40)

The classification of the "maculipennis complex" is one of the most difficult and controversial in the systematics of mosquitoes. A number of "races" of maculipennis have been described and later considered as subspecies. The following six forms occur in the Palaearctic: maculipennis Mg., messeae Fall., melanoon Hack. (subalpinus Hackett and Lewis), labranchiae Fall., atroparvus van Thiel, sacharovi Favre. The last was described as a distinct species. In a monograph of A. maculipennis (Beklemishev, 1944), all these forms are considered as subspecies.

It was later suggested that these subspecies be raised to the rank of species (Bates, 1940). This was accepted by some authors, but not generally. It was stressed that some forms of the maculipennis complex were more closely related to each other than to other forms. The groups of the complex were suggested as species. This "compromise" was accepted by many authors, e.g. Stone et al. (1959). Instead of the one species A. maculipennis in the Palaearctic, three species have been accepted: maculipennis (with the subspecies messeae and melanoon), labranchiae (with the subspecies atroparvus) and sacharovi. The North American A. occidentalis D.K. is also considered as a distinct species. These four species plus several related species form the group maculipennis, which is considered as one of the six groups into which the subgenus Anopheles was divided (Reid and Knight, 1961; this
91 division of Anopheles into six groups was previously suggested by Edwards, 1932). It was also suggested that this group should form the subgenus Maculipennia (Buonomini and Mariani, 1953), but this has not been accepted.

Those in favor of dividing maculipennis into several species state that they can be recognized by the structure of the dorsal surface of the eggs and by important biological differences (see below). It has been
92 emphasized that the forms do not cross and that there is therefore reproductive isolation in their common habitat (2–3 forms often occur in the same locality).

In our opinion the following considerations should be taken into account in the classification of the maculipennis complex.

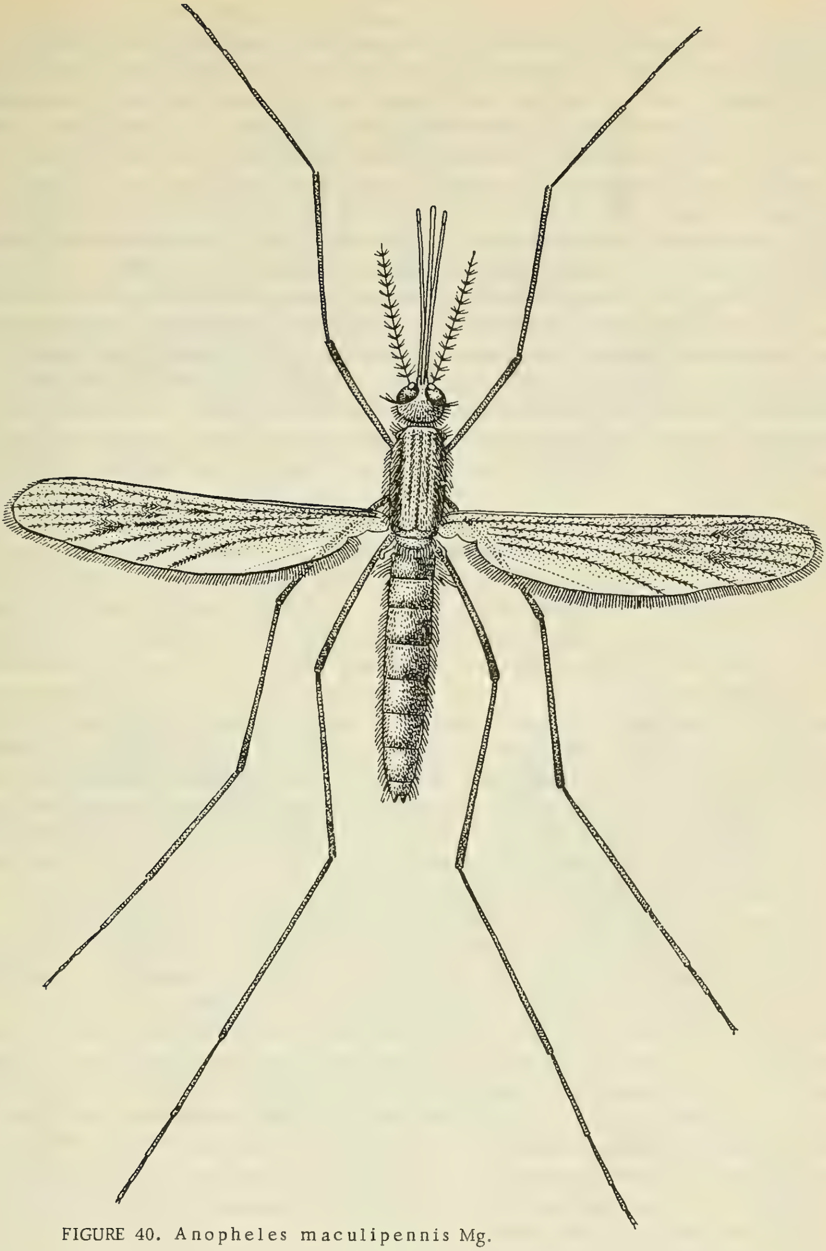


FIGURE 40. Anopheles maculipennis Mg.

The classification of mosquitoes is based mainly on the aggregate of characters of the adult mosquitoes (female and male) and the larvae. We therefore give three keys for each species. All Palaearctic species of mosquitoes are determined by at least one of these three "phases." This principle gives a firm support to classification, and we see no reason to reject it.

No reliable differences have been found so far between forms of the complex, between the larvae or the imago or, particularly, the structure of the hypopygium. Determination is possible only according to oviposition. The difference between sacharovi and the other forms of the complex are very small and at most of the rank of subspecies. Differences in the structure of the hypopygium, mainly in the form of the spines on the claspettes, have also been described. A study of the armature of the claspettes of different forms of A. maculipennis has shown that individuals cannot be identified by this character and that there is variation of the character in all subspecies (Denisova, 1940, 1948, 1964).

As to biological characters, important intraspecific differences are present in many species. Thus, in many species autogenous and anautogenous populations have been found. These are apparently intraspecific groups, biotypes, or perhaps subspecies. If other polymorphic, widely distributed species had been studied as extensively as A. maculipennis, the same heterogeneity would probably have been found and there would be the problem of the division of many species; but this would not be justfied in our opinion.

Strict reproductive isolation between species of the maculipennis complex is based mainly on experiments with atroparvus, which is easily bred in the laboratory. It is not known how complete and universal is the reproductive isolation of the forms of the complex. Experimental crossing of subspecies has not always given the same results. The production of fertile progeny depends on many factors. Thus, in experiments in hybridization of labranchiae × atroparvus, the result depended on whether the mosquitoes were captured wild or bred in the laboratory (Mariani et al., 1964). In other species, e.g. Culex pipiens, at least partial crossing between different subspecies and even populations is known.

The partial or even complete reproductive isolation of subspecies proves only the developing divergence which, however, has not advanced sufficiently to result in the formation of new species. Only sacharovi stands on the verge of transformation into a distinct species.

We consider, therefore, A. maculipennis as a single, polytypic
93 species with 6 Palaearctic subspecies: maculipennis, messeae, melanoon, labranchiae, atroparvus and sacharovi. The latter is more differentiated in some respects. Only this species is listed separately in the keys of females and larvae. We think that species status of these forms disturbs the continuity and proportion in the classification of the subgenus Anopheles since the differences between the forms are of a different character and smaller than the differences between other species of the subgenus Anopheles of the Palaearctic fauna. The taxonomic rank of the varieties of A. maculipennis is of no basic importance since, as Darwin stated, a variety is a developing species.

We give below the description of A. maculipennis including all Palaearctic subspecies except A. m. sacharovi, followed by the distinctive characters of the subspecies. The more important morphological and biological characters of the subspecies are compared in the table (see p. 98).

Anopheles maculipennis varies widely in coloration and size. Specimens from southern localities are usually lighter and smaller.

Head: Occiput with upright, dark brown scales, with a tuft of long, whitish scales and hairs directed anteriorly on the vertex. Antennae brown. Palps and proboscis brown, mainly with adpressed scales. Mesonotum with a broad, median, grayish longitudinal stripe which tapers anteriorly and there are usually 2–3 indistinct brownish stripes in its anterior half. At the anterior margin of the mesonotum is a tuft of whitish scales. Lateral parts of mesonotum brown anteriorly, blackish brown posteriorly. Hairs in median part of mesonotum and on the scutellum pale brown, otherwise dark brown, especially above the base of the wings. Legs brown on ventral side of femora, lighter on inner side of tibiae. Tarsi dark. Wings with brownish scales, with 4 spots of blackish brown scales at base of radial and medial fork, at cross-veins and in basal part of stem of $r_2 + r_3$; scales at margin of wing usually pale, yellowish at the apex. Halteres yellow, with brownish head. Abdomen brown, sometimes blackish brown, often with lighter spots in lateral parts of tergites; abdomen with long, golden yellow or brownish hairs.

(94)

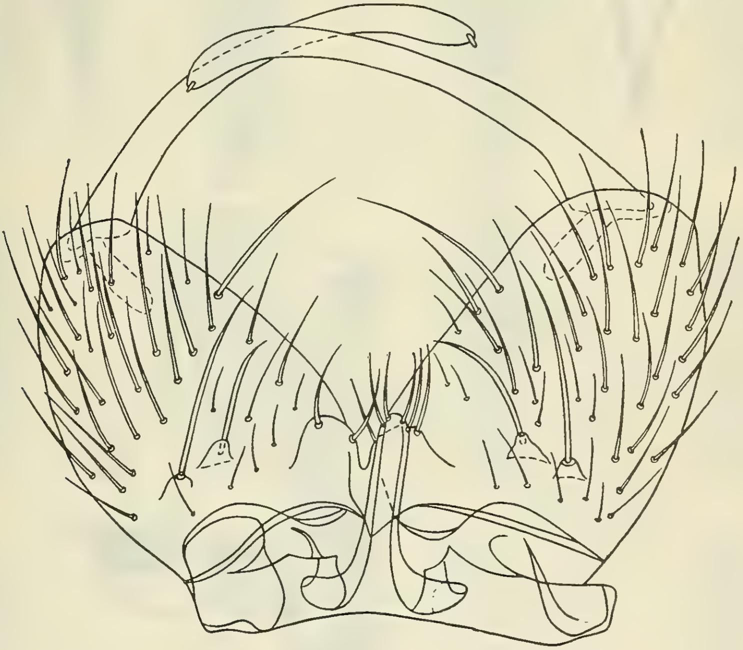


FIGURE 41. Hypopygium of Anopheles maculipennis Mg.

Hypopygium (Figure 41) with one strong seta near middle of inner side of coxite; two large setae situated on tubercles at base of coxite. Spines on claspettes situated close together but not fused. The spines vary in form (blunt or pointed), and their number also varies. Aedeagus long, narrow, with leaf-shaped appendages at the apex. The differences between the larvae of the subspecies of A. maculipennis are so small that no

(95)

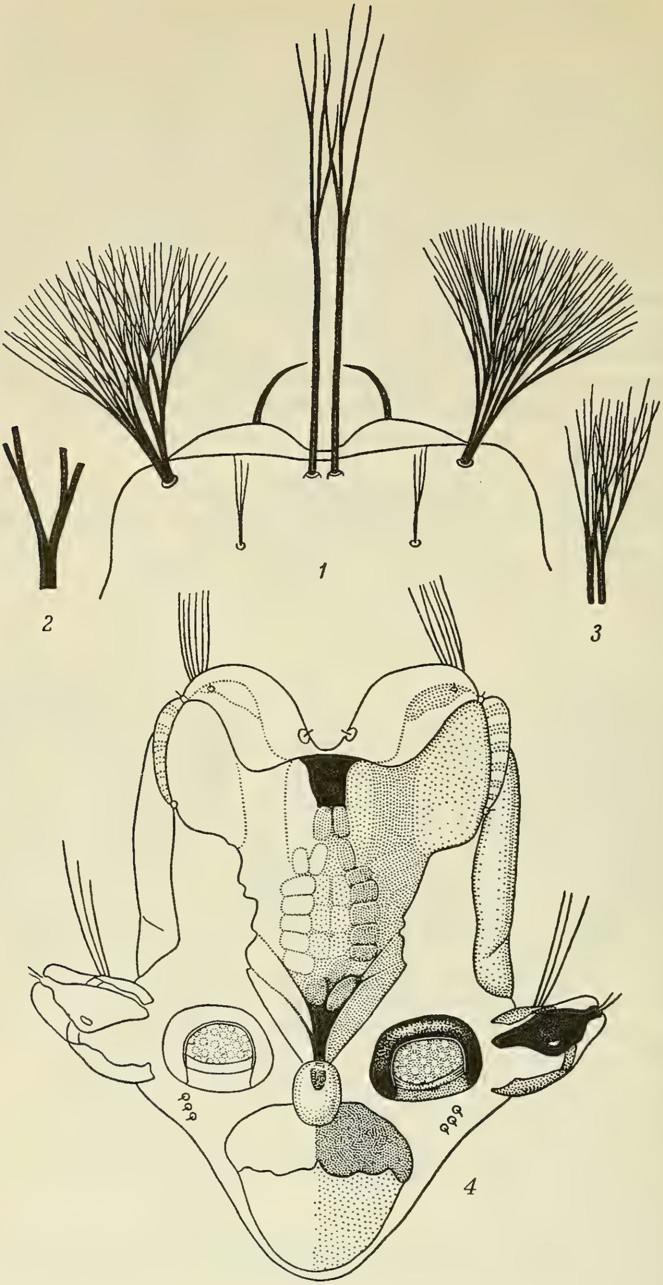
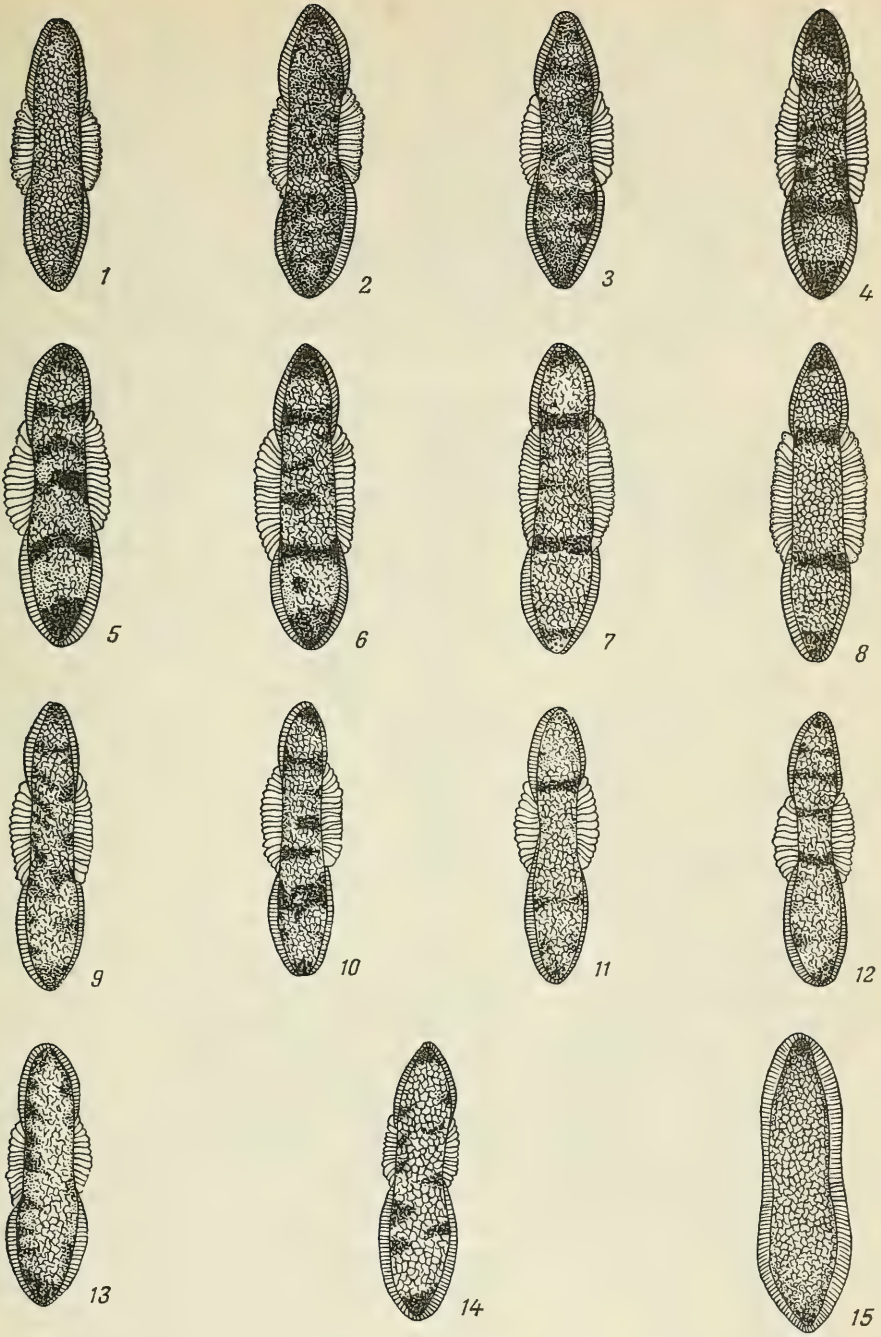


FIGURE 42. Anopheles maculipennis Mg. Fourth-stage larva:

1 – anterior margin of frontoclypeus; 2 – base of outer clypeal hair (dichotomous branching); 3 – strong branching of inner clypeal hairs; 4 – stigmal plate.

(96)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Eggs of subspecies of Anopheles maculipennis Mg. (after Missiroli, Hackett and Martini):

1 – A.m.subalpinus (dark form, melanoon); 2–6 – A.m.messeae; 7–8 – A.m.maculipennis; 9–12 – A.m.atroparvus; 13, 14 – A.m.labranchiae; 15 – A.m.sacharovi.

Subspecies of Anopheles maculipennis Mg.

	Egg (see figure on p. 97)		Biological characters	Geographical distribution
	Color of upper surface	Air floats		
Group maculipennis A.m.maculipennis Mg.	Two dark transverse stripes at outer ends of air floats; dark spots between the stripes absent (sometimes 1–2 spots).	Well developed; surface of cells between the ribs ("intercostal membrane") wrinkled, rarely smooth.	Copulation in flight. Hibernation in cold, rarely warm, buildings; sometimes sucking blood in winter.	Europe to 60–62° in the north, south to Spain, Italy, Greece; West Siberia; mountain regions in Middle Asia (Kopet-Dagh), Transcaucasia; Northern Iran. Common in the Caucasus.
A.m.messeae Fall.	In addition to the dark transverse stripes (which are sometimes indistinct), there are dark spots in the space between the stripes.	Well developed, longer than in maculipennis; intercostal membrane wrinkled.	Copulation in flight. Hibernation in cold buildings; not sucking blood in winter.	North and Central Europe, North Asia; to the borders of the distribution area in the west, north and east; in the south to Spain and Greece and to the Caucasus, Central and southeastern Kazakhstan, to northern Kirghizia in the USSR. Mongolia, Northeast China.
A.m.melanoon Hack. (subalpinus Hack. and Lewis)	Dark or paler, with transverse stripes and dark spots between them (contrasting pattern against the pale background).	Well developed but shorter than in maculipennis; intercostal membrane smooth or slightly wrinkled.	Copulation in flight. Hibernation often in warm buildings; may suck blood in winter.	Southern Europe, Transcaucasia (predominant or only subspecies); rare in the Northern Caucasus.
Group labranchiae A.m.labranchiae Fall.	Transverse stripes at ends of floats absent; pattern consisting of dark spots extending from the margin and tapering toward the middle. General color darker in A.m.atroparvus and paler in A.m.labranchiae.	Well developed but relatively short; intercostal membrane smooth or slightly wrinkled.	Copulation in flight. Usually hibernating in warm buildings; sucking blood in winter.	Western Mediterranean to Yugoslavia and Libya in the east, not reaching the Pyrenees or the Alps in the north. Not found in the USSR.
A.m.atroparvus van Thiel			Copulation in resting position or in flight. Readily breeding in the laboratory. Hibernation in warm buildings; sucking blood in winter.	Europe, to 55–56° in the north, to Spain, Italy and the Balkans in the south. USSR: Caucasus, Ukraine, Belorussia.
A.m.sacharovi Favre (Elutus Edw.)	Uniformly gray	Floats absent or rudimentary	Copulation in flight. Hibernation in warm buildings; may suck blood in winter.	Eastern Mediterranean, Italy, Balkans, North Africa, Southwest Asia. Middle Asia (usually the only subspecies), Caucasus (eastern plains). Iran, Afghanistan, West China.

characters have been found which would permit their reliable determination. A study of extensive material with variation-statistical methods indicated differences in the average number and relative development of the branches of some hairs (Nos. 1–6, after Martini) on the dorsal side of the abdominal segments with marked overlapping of extreme variations in all subspecies, so that the determination of single larvae is impossible. We therefore give only the description of the larvae of A. maculipennis and of A. maculipennis sacharovi, in which the differences are sufficiently distinct.

Fourth-stage larvae (Figure 42) are very variable in appearance, color and size because of their different habitats and conditions. Larvae from northern latitudes are usually larger, with darker chitinized structures (head, stigmal plate, etc.). The color varies from grayish yellowish green to blackish green, according to the color of the environment and the illumination of the water.

Head with variable pigmentation, from the usual light brown spots to blackish brown stripes against a dark background. Clypeal hairs: inner hairs situated close together, with 3–8 branches at the end; outer hairs dendriform. The branching is variable: the stem is often divided into 2 branches, which branch dichotomously or dendriform in the horizontal plane; the stem has rarely three or more branches which branch further. Hairs directed obliquely anteriorly. Outer clypeal hairs not reaching anterior margin of lateral lobes of labrum, situated on its base. Postclypeal hairs short, slightly branched, with 2–8 branches, extending slightly beyond base of anterior hairs. Antennae nearly straight, $^2/_3$ as long as the head,
97 with darker end; hair short (Figure 48), usually as long as width of antennae at its position, situated near the base, with 4–6 thin branches.

Median hairs of prothorax: outer hairs short and simple, median hairs feathered, with 3–7 lateral branches on each side, inner branches nearly half as long, slightly branched at the end. Palmate hairs on metathorax rudimentary.

Palmate hairs present on segments 3–7, with 16–24 leaflets which are slightly wider in the middle, which is more strongly pigmented. Terminal filament $^1/_3$ of the length of the leaflet. It is often pointed at the end, its base passing in irregular steps into the widest part of the leaflet.

Stigmal plate large: 0.5–0.57 mm long, width between ends of lateral valves 0.56–0.59 mm. The chitinized areas are usually strongly pigmented. Anterior lobe with dark base, distinctly lighter otherwise. Spiracles without processes, situated some distance from the central plate. The base of the anterior process of the central plate does not reach the border between its anterior and median parts, passing into the folds and outlines of the alveoli in the median part. This is darkly pigmented from the posterior margin to the middle of the posterior part and then passes anteriorly into the granulated part which covers the entire median part and the posterior half of anterior part. It may be complete or the alveoli diverge to the sides in the median part leaving a lighter median area. If the granulation is complete, the alveoli of the median part may form a darker stripe than in A. claviger.

The comb on segment 8 consists of 6–10 (usually 7–9) large, awl-shaped denticles and between them are 1–4 much smaller denticles.

Lateral hair on saddle long, usually simple. Outer caudal hairs asymmetrically branched, their ends curved, inner hairs branched more strongly on the dorsal side. Fin with 18–20 tufts. Gills usually as long as the saddle, both pairs of the same length.

The eggs of A. maculipennis, except those of A. m. sacharovi, have air floats which occupy the middle third and a fringe. The structure and color of the exochorion differ but are characteristic for the subspecies, This depends on changes of the structure of the exochorion and consists of dark and light spots and stripes. The differences of this character in the various subspecies are given in the table on p. 98 and in the figure on p. 97.

Distribution. Europe, North Africa, North Asia (we are not including the North American form, which many authors now consider a distinct species, A. occidentalis D.K.). The most northern record of A. maculipennis is from southwest of Murmansk, 69°N (Solovei and Likhoded, 1966). The distribution then extends southeast (Karelia at 66°) and east along the Lena River at about the same latitude in river valleys and then further south along water divides and especially in mountains. From Yakutsk the border of distribution, which is not well known in this area, extends south and crosses the Amur valley about 150 km east of Blagoveshchensk.
98 The area of distribution also includes Northeast China, Mongolia, Sinkiang, Northern Afghanistan and Iran near Transbaikalia, Southwest Asia and some parts of North Africa.

Biology. There is a large literature on the ecology of A. maculipennis, including a monograph by Beklemishev (1944). We give below only a few of the more important ecological aspects which are valid for all subspecies.

The larvae breed in permanent and temporary stagnant water bodies of varying type, depth and size, with full sunshine (partly shaded in the south) and with filamentous algae and other aquatic vegetation. They occur in permanent water bodies among aquatic plants which form a "second bottom" at the surface. When the water bodies dry up in summer, they are found in shallow water and in the backwaters of slowly flowing streams. They occur in slightly brackish water in the south.

The females hibernate in empty buildings, often in stables, rarely in caves or burrows. In the northern and eastern parts of the range the mosquitoes hibernate in empty buildings for many months at low temperatures (A. m. messeae).

The phenology of the species has been thoroughly studied according to the conditions in different landscape zones (Beklemishev and Shipitsina, 1957). In warm weather, when the temperature is favorable for reproduction (minimum of development at about 10°), the species produces a number of generations: 2 generations in the north, 4–6 in the south. The maximum number of adults appears in midsummer, but in regions with a very hot summer there is a decrease in numbers in July–August.

Most mosquitoes are concentrated in populated areas and their vicinity. They feed mainly on farm animals (cows, horses, pigs, etc.) and to a lesser degree on people. If there are few or no animals they attack mainly people. They may also feed on domestic and wild birds.

A. maculipennis is an obligatory bloodsucker. A blood meal is necessary for reproduction. Autogenous development of the eggs has not been observed in A. maculipennis. Gonotrophic harmony in the summer is characteristic for this species (probably for the whole genus). One complete blood meal is sufficient for the development of eggs.

Epidemiological importance. A. maculipennis was a dangerous carrier of the three main types of malaria in the past. In most of Europe, Kazakhstan, Siberia and Transbaikalia it was virtually the only vector of malaria. In the southern parts of its area of distribution it also carried malaria together with other species (and still does in some places).

A. maculipennis is an intermediate host of the filariae of dogs Dirofilaria immitis and D. repens.

It transmits Čalova virus in Czechoslovakia.

A. maculipennis may also have a part in spreading tularemia. Natural infections have been found.

99 Anopheles maculipennis sacharovi Favre, 1930
(elutus Edwards, 1921)

It differs from the other subspecies in its lighter coloration. Lateral parts of mesonotum yellowish brown, more or less as in the middle. Dark spots on the wings, especially in males, weakly defined and not distinguishable in old specimens. The scales at the margin of the wings are of uniform color, without a light spot at the apex.

These characters are not certain and determination of adults is not always possible.

(100)

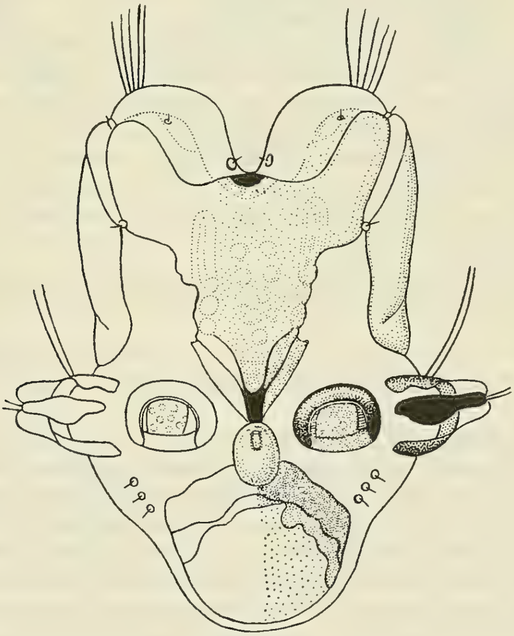

FIGURE 43. Anopheles maculipennis sacharovi Favre. Stigmal plate of 4th-stage larva.

Fourth-stage larva (Figure 43) closely resembling that of A. maculipennis but usually smaller. The differences are only quantitative, small and variable. Light yellowish green larvae, with weakly pigmented head and stigmal plate are common. The head pattern is not sharp and resembles that of the newly molted larvae of A. maculipennis. The hair on the antenna and the outer clypeal hairs are relatively longer and extend to the anterior margin of the extended lateral lobes of the labrum, or even slightly beyond them. However, there are many exceptions. This also refers to the variation of the number of leaflets of the palmate hairs which are usually fewer in A. m. sacharovi than in maculipennis but their form is identical.

The stigmal plate differs from that of A. maculipennis in size and in the intensity of pigmentation of the central plate. It varies markedly in size but is distinctly smaller and more weakly pigmented. It is 0.38–0.5 mm long and the width between the ends of the lateral lobes is 0.39–0.52 mm. The central plate has a very weak, light, median granulation. The dark area in the posterior part reaches to the posterior margin. It is interrupted anteriorly and is distinct only in the middle. The base of the anterior process barely reaches the anterior part, where it forms folds which only rarely, in less pigmented larvae, reach to the middle section.

Eggs deposited in spring, summer and autumn have no floats, only a fringe. However, in the south of the range, where development in winter continues, eggs deposited in winter have small air floats, but the number and size of the cells are very variable.

Distribution. Mediterranean, mainly the eastern part: Italy, southern Balkan, Southwest Asia. In the USSR: Middle Asia to the Aral Sea and Kirghiz Range, Eastern Transcaucasia, Dagestan. It also occurs in Iran, Afghanistan and the part of Sinkiang near to Middle Asia.

Biology. It occurs mainly in arid zones, where it is common. The larvae breed in open, sunny, shallow water rich in algae and with sparse higher aquatic vegetation. They tolerate distinctly saline water. They are often found together with the larvae of Culex modestus Fic. They are little mobile, rarely leaving the surface.

100 A. m. sacharovi is a serious vector of malaria everywhere.

6. Anopheles (Anopheles) lindesayi Giles, 1900

Coloration dark brown. Head black, with dense, black, upright scales on sides of occiput, middle of occiput white, with upright scales; vertex with a tuft of yellowish white hairs between the eyes, directed anteriorly. Antennae as in A. maculipennis, palps and proboscis black. Mesonotum light ash gray in the middle, dark brown at the sides, with a wide longitudinal stripe bordered by a narrow, grayish stripe. Sides of thorax mainly dark, scutellum gray, hairs on thorax pale yellowish. Legs blackish brown, coxae and trochanters pale, hind femora with a broad, white ring in $^{3}/_{4}$ of its length. Wings mainly with dark scales; there is a large white spot on the costa near the apex of the wing which extends to r_1 and r_2; white scales present in middle of r_3, in basal part of r_{4+5}, in middle of m_1, in basal and apical thirds of m_{3+4} and at ends of veins r_{4+5}, m_2, cu_1 and an; halteres pale, with black head. Abdomen blackish brown, grayish ventrally, with long, brownish hairs.

(101)

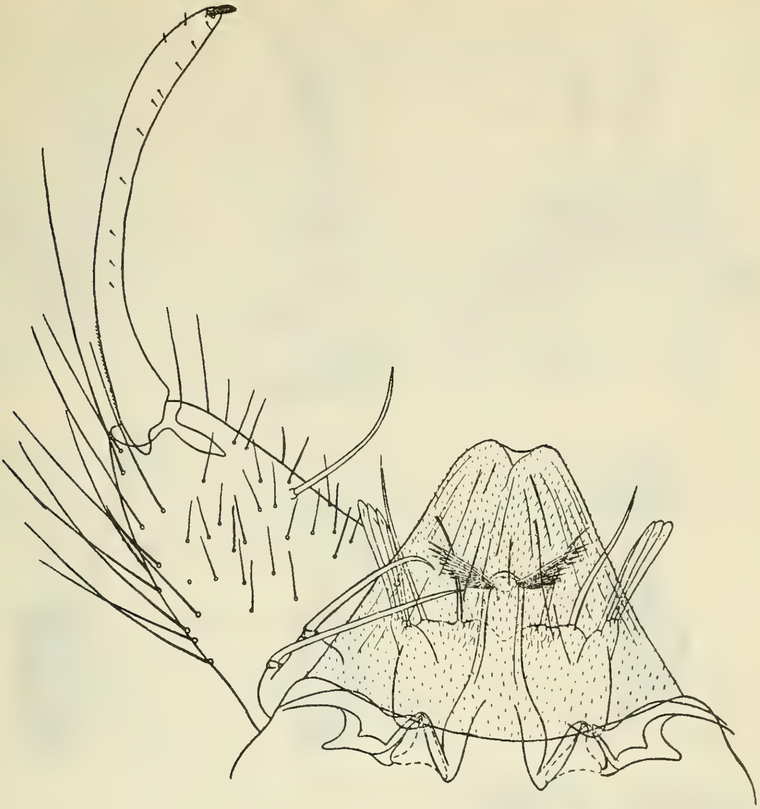

FIGURE 44. Hypopygium of Anopheles lindesayi Giles (after La Casse and Yamaguti)

Hypopygium (Figure 44) with two setae at the base of the coxite; spines at end of claspettes fused, forming a long, narrow plate; lobes of tergite 9 short, conical.

101 Fourth-stage larva (Figure 45) to 6 mm long, gray or grayish green. Head yellowish brown or dark brown. A dark, oval spot in the middle of the frontoclypeus near its posterior margin that extends anteriorly beyond the base of the frontal hairs; near the eyes are two small, oval spots. Clypeal hairs simple, postclypeal hairs rarely 2-branched at the end; inner clypeal hairs situated close together, very long, outer hairs $\frac{1}{2}$—$\frac{1}{3}$ shorter, postclypeal hairs as long as the outer clypeal hairs. Frontal hairs short, the longest inner hair hardly reaching beyond the base of the postclypeal hairs. Antennae more strongly pigmented at the apex, hair short, situated near the base, with 6—9 branches.

Hair No. 1 on metathorax palmate, distinct, with 15—22 leaflets without terminal filament, sometimes rudimentary. Palmate hairs of abdomen well

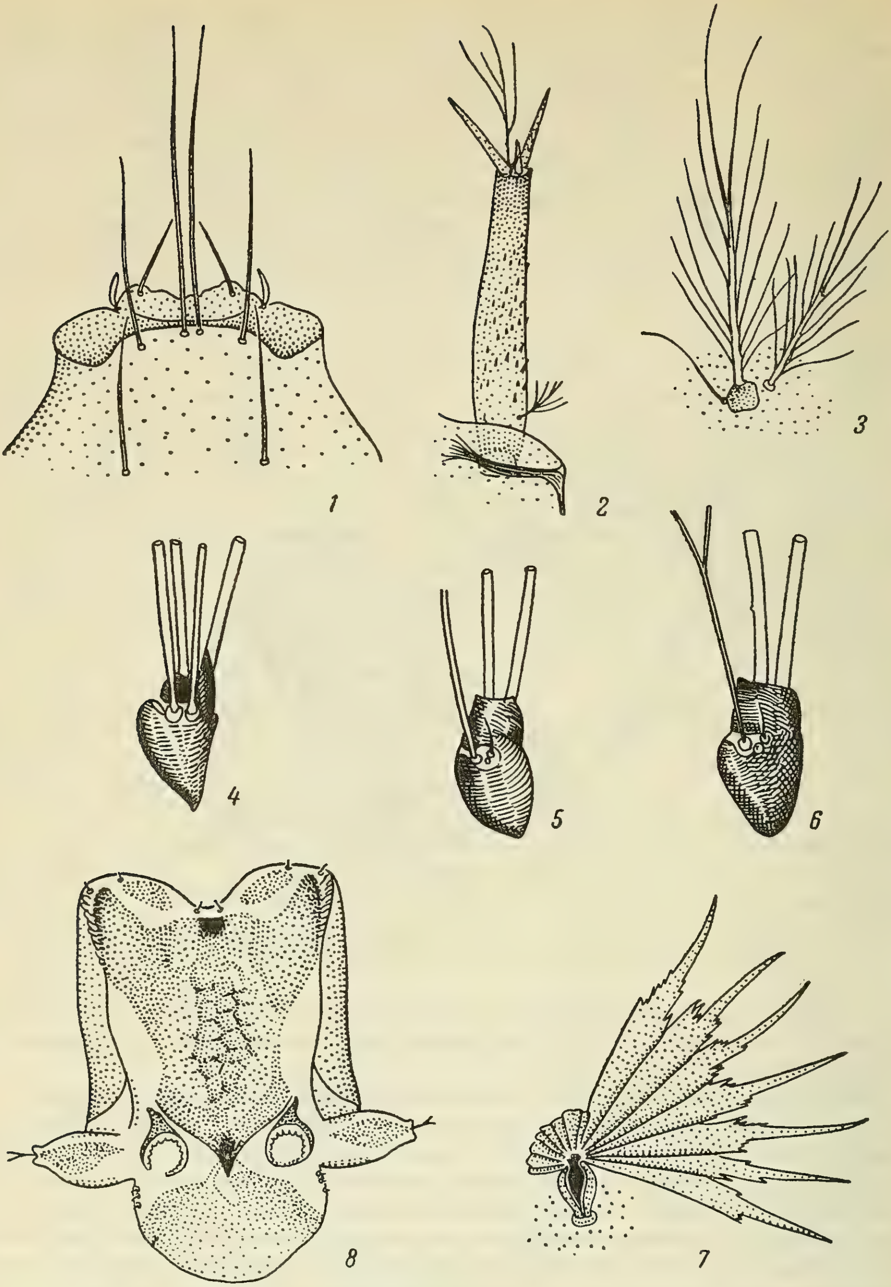

FIGURE 45. Anopheles lindesayi Giles. Fourth-stage larva (after Puri):

1 – anterior margin of frontoclypeus; 2 – right antenna, inner side; 3 – median hairs of prothorax; 4–6 – bases of lateral hairs of prothorax, mesothorax and metathorax; 7 – palmate hair of 4th abdominal segment; 8 – stigmal plate.

developed on segments 2—7, with 13—17 leaflets on segment 2, 19—24 on segments 3—6 and 15—19 leaflets on segment 7. Leaflets dark, with a long terminal filament. At the base of the filament are long denticles, which pass gradually into the filament.

Stigmal plate with an anterior lobe which is dark at the base, lighter
103 anteriorly. Processes of spiracles usually distinct; if they are absent, the anterior part of the central plate is adjacent to the spiracles; its margins are distinctly striated, granulation in the middle distinct but only slightly darker than the lateral parts.

Distribution. USSR: mountain regions of Tadzhikistan, 800—1,600 m above sea level (Keshish'yan, 1938). Mountain regions of India, Malaya, China, Philippines. The subspecies A. lindesayi japonicus Yam. occurs in Japan.

Biology. The larvae occur in shaded mountain streams with little vegetation and in streams with pure, cold water (11—15°). They are found mainly in weaker currents and in winding areas near the bank. The larvae hibernate. The mosquitoes bite man at dusk, also outdoors.

Anopheles lindesayi lindesayi Giles

The strongly developed white scales on the ventral surface of the hind femora cover about 1/3 of the femur from the base.

Anopheles lindesayi japonicus Yamada, 1918

It differs from the nominate subspecies in the weak development of white scales on the ventral surface of the hind femora which cover only about 1/6 of the femur from the base. The larvae do not differ from those of the nominate subspecies.

Distribution. Japan (Hokkaido, Honshu, Kyushu), Korea, China.

Biology. It occurs in northern regions. The larvae are found together with those of Anopheles koreicus Yam., A. hyrcanus, Culex hayashii and C. infantulus Edw. They prefer pure water.

7. Anopheles (Anopheles) hyrcanus Pallas, 1771
(?sinensis Wiedemann, 1828) (Figure 46)

Markedly varying in size and coloration.

Head dark brown, with blackish brown upright scales at sides of occiput, white scales dorsally; a tuft of white hairs directed anteriorly situated on the vertex between the eyes; proboscis and palps dark brown, palps of females with 3 white rings and white apex; there are sometimes also white scales on the palps; the palps of the female, especially in the basal half, are covered with upright scales. Antennae of female dark brown, with white pubescence, with long, brown hairs; the first 5—7 antennal segments bear some white scales. Mesonotum brown, with a more or less distinct, broad, gray stripe in the middle, often divided by dark longitudinal stripes into

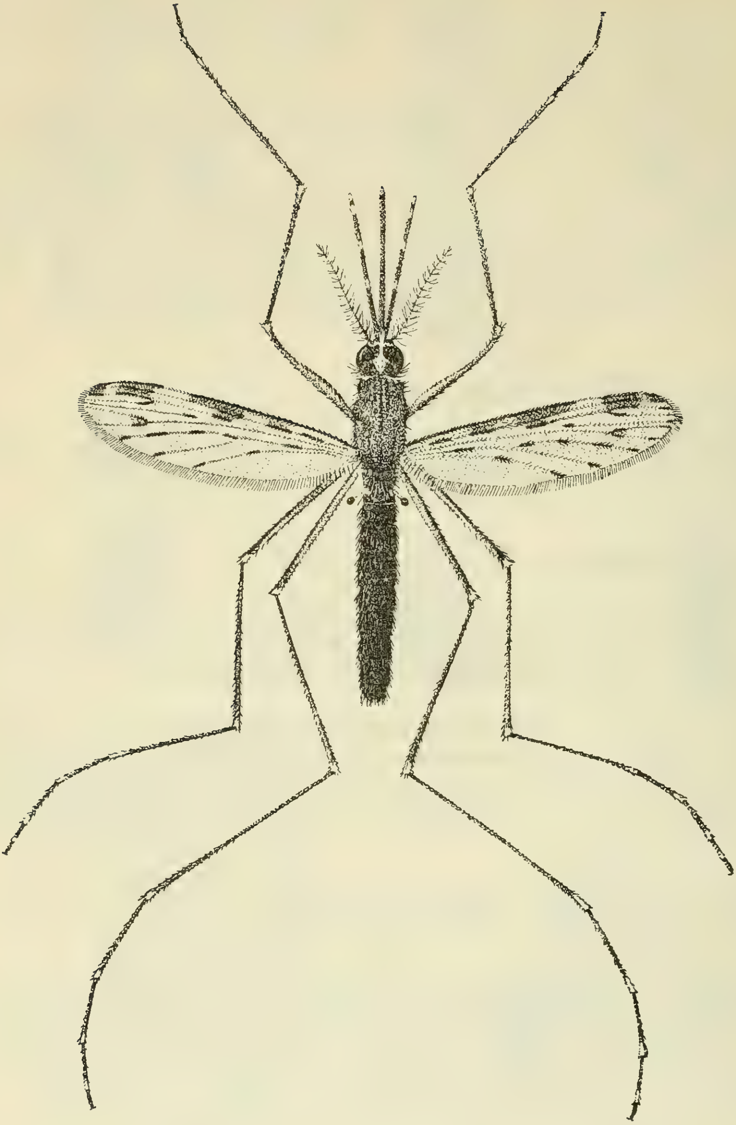

FIGURE 46. Anopheles hyrcanus Pall.

105 two or four narrow gray stripes; mesonotum, except for the narrow stripes, sometimes covered with gray tomentum. At the anterior margin of the mesonotum is a tuft of white scales. Hairs on mesonotum yellowish brown. Sides of thorax brown, with grayish tomentum. Legs brown, lighter at ventral side of femora and inner side of tibiae. Base of fore femora distinctly thickened. Tarsi dark brown, with white rings at the apex of the first 3 or 4 tarsal segments, particularly on the hind legs, or whole 4th tarsal segment of hind legs white; the white color sometimes also extends to part of the 5th segment. Wings mainly with dark scales; there are two large white spots at the anterior margin, one at the distal third, the other near the apex. The first spot extends to r_1 and the second to r_2. Constant areas of white scales are present in the basal third of r_1, at the forks of $r_2 + r_3$ and $m_1 + m_2$, m_{3+4} and particularly on the cubitus and anal vein which are sometimes mainly covered with white scales. There are sometimes also scattered white scales between the brown scales. Fringe of wing white at the apex, otherwise brownish; halteres pale, with brown head. Abdomen brown, with long, dense, brown or golden hairs.

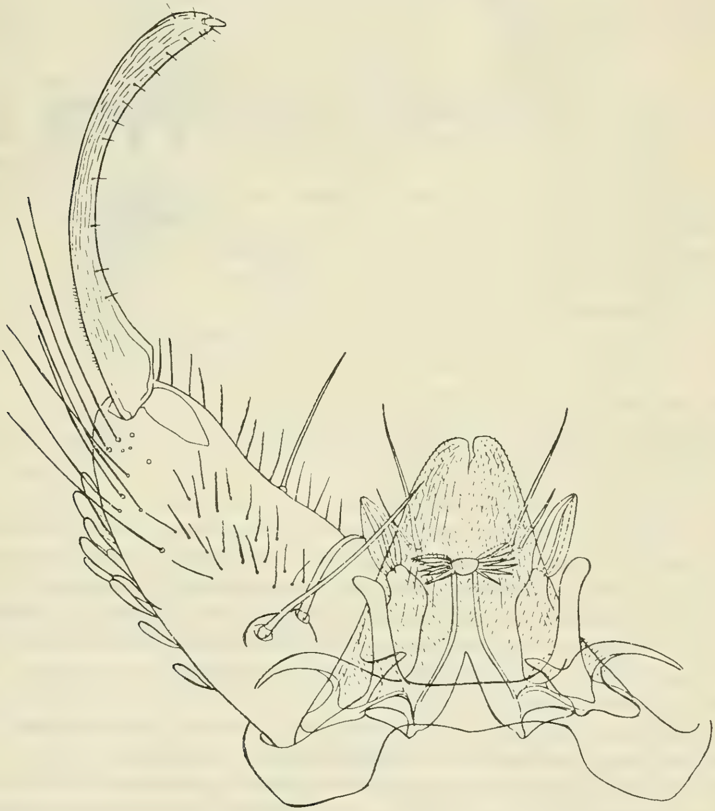

FIGURE 47. Hypopygium of Anopheles hyrcanus Pall. (after La Casse and Yamaguti)

Hypopygium (Figure 47): coxite with 2 strong, simple setae on the inner side near the base. Spines of claspettes fused, forming a narrow plate; tergite 9 with long, narrow processes.

Fourth-stage larva (Figure 48) very variable in color and pigmentation of chitinized formations, particularly of the head and stigmal plate.

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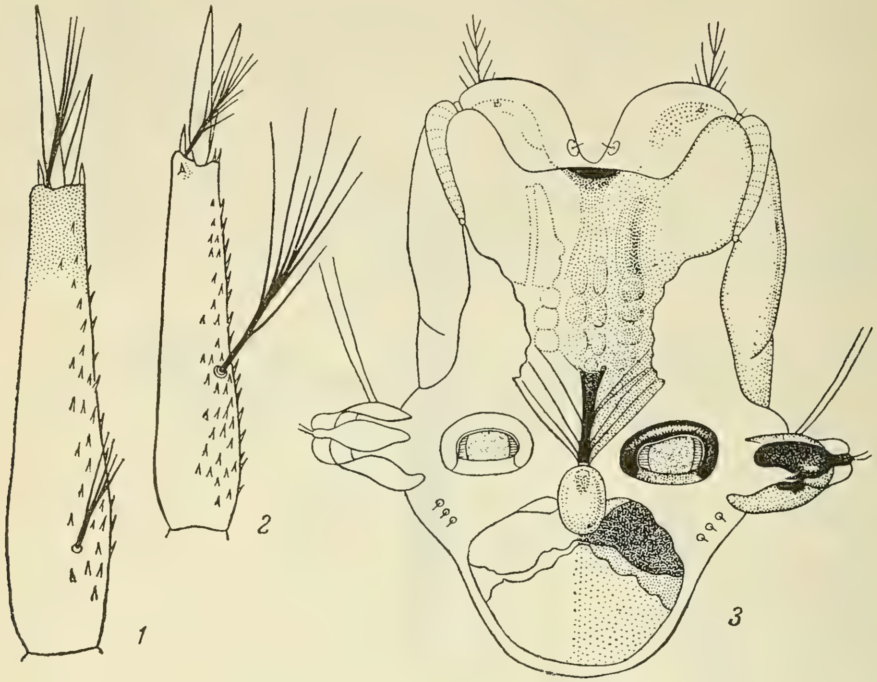

FIGURE 48. Antennae of larvae:

1 – Anopheles maculipennis Mg.; 2 – Anopheles hyrcanus Pall.; 3 – stigmal plate of 4th-stage larva of A. hyrcanus.

Inner clypeal hairs situated close together, simple or often slightly branched at the ends; outer hairs about $2/3$ as long as the inner hairs; they may reach to the anterior margin of the lateral lobes of the labrum, dendriform. From the main stem extend 3–6 branches which are repeatedly branched, the inner branches longer than the outer branches; postclypeal hairs weakly developed, with 2–3 branches, reaching to the base of the anterior clypeal hairs.

Antenna with a strongly developed hair near the middle, with 7–8 branches, at least half as long as the antenna or longer.

Hair No. 1 on metathorax weakly developed, with long leaflets without a terminal filament. Palmate hairs rudimentary on segments 1–2, well developed on segments 3–7, with 17–24 leaflets with indistinct terminal filament passing in steps into the leaflet, which is dark in the basal half and light at the apex.

Stigmal plate dark only at base of anterior lobe, spiracles not connected with anterior part of central plate; the dark base of the central plate extends beyond the border between the anterior and middle part; median dark pigmentation of posterior part of central plate weakly developed only at the posterior margin; granulation light, present only in the middle near the posterior margin, without dark outline.

107 Eggs with medium-sized air floats and a broad, smooth (not striated) fringe.

Note on systematics. This species has been treated differently. The Oriental forms which were described as subspecies of A. hyrcanus (nigerrimus Giles, 1900; pseudosinensis Baisas, 1935; lesteri Baisas and Hu, 1936) are now considered as distinct species. The Oriental sinensis Wied., described from Canton, possibly differs from the Palaearctic A. hyrcanus (see Reid, 1953).

Intraspecific variations (aberrations) of A. hyrcanus have been described from the Palaearctic, particularly ab. pseudopictus Grassi (with a white 4th segment of the hind tarsus) and ab. mesopotamiae (with a light, diffuse pattern of the wing). However, in view of the wide variation of A. hyrcanus, there is no reason to consider these forms as subspecies (Maslov, 1946).

"Ab. mesopotamiae" is probably a seasonal form, as the light, diffuse pattern of the wings is found mainly among hibernating females (Kazantsev, 1930). A. chodukini Mart., 1929, described from Tashkent, is probably an albinistic form.

Distribution. It occurs from the Atlantic to the Pacific, including South and Southeast Europe, West, South and East Asia, and some regions of Central Asia (Mongolia, Sinkiang). This species and closely related groups are common in Southeast Asia (India, Sunda Islands, and Philippines), from where it extends far to the north and west in the Palaearctic. The eastern area of distribution is represented by China, Japan, Korea and the southern Maritime Territory (especially common near Lake Khanka and extreme southern coast of the territory). The northern border crosses the Amur and Aman' and then passes into Mongolia and China. From the upper reaches of the Irtysh (Lake Norzaisan) the northern border passes to Central Kazakhstan and to the lower reaches of the Ural, Volga and Don rivers, south of Kharkov and Kiev, and slightly north of Kishinev. It also occurs in South and Southeast Europe and Southwest Asia. It is widespread in Southern Kazakhstan, Middle Asia and the Caucasus, in river valleys and deltas. It occurs to 1,500–1,600 m in the mountains.

Biology. The larvae breed in stagnant water warmed by the sun and overgrown with vegetation, in small and large swamps and lower reaches of rivers covered with bulrushes. They also occur in rice fields and irrigation canals. In the north and northeastern parts of the range (Far East), especially in winter, they breed mainly in open water. In the south, and other parts of the area of distribution, during the hot season, they inhabit shaded, muddy water with rich vegetation and medium mineralization and high oxidation. They occur together with larvae of Anopheles pulcherrimus, A. maculipennis sacharovi, Culex modestus and others. The females hibernate among reeds in riparian forests, shrubs, etc. They are active from spring to November and their numbers increase in autumn. There are two (in the north) to four generations per year.

This species has little contact with man. The females rarely enter 108 houses but do enter cattle sheds. After bloodsucking they fly away. They pass the day mainly in thickets of twinflower. They bite mainly in the open air, at dusk and in the night, but also in sunlight. Their attacks in riparian forests are sometimes in large numbers and persistent. In the southern Maritime Territory their breeding places are close to human habitations and they commonly enter houses.

The epidemiological importance of the species depends on the conditions of the locality. In the Caucasus and Middle Asia it is of minor importance as a vector of malaria in the valleys of large rivers in the plains. A. hyrcanus did not become infected experimentally with tropical malaria but was infected with tertian malaria (Simanin, 1930). In the Far East (southern Maritime Territory) it was the only vector of malaria but it did not become widely distributed. In East Asia (Korea, some parts of China and Japan) it is the main vector of malaria.

A. hyrcanus probably plays a part in the circulation of tularemia in some river foci. Natural infections have been found.

2. Subgenus Myzomyia Blanchard
(Cellia Theobald)

Cross-veins and base of forks of wing with white scales; costa with 4 or more white spots. Hypopygium with 4–6 large setae at base of coxite.

The subgenus Myzomyia is mainly distributed in the Oriental and Ethiopian regions. About 80 species have been recorded from the Ethiopian region and 45 from the Oriental region. Fourteen species occur in Australia, but none in America. The West Palaearctic species are closely connected with the Ethiopian region (Mediterranean) and the eastern species, particularly A. pulcherrimus, with the Indian part of the Oriental region.

The larvae of Myzomyia have widely separated inner clypeal hairs, the distance between them larger than the distance between the outer hairs and the inner hairs. Frontal hairs feathered. Antenna with a short simple hair. Long, feathered, lateral hairs are present on abdominal segments 4–6.

8. Anopheles (Myzomyia) pulcherrimus Theobald. 1902

The species differs from the other species, except from the African A. pharoensis, by the distinct tufts of scales at the sides of the abdominal tergites and the white segments 4 and 5 of the hind tarsi.

Head with light brown, upright scales laterally, white scales dorsally, and with an anteriorly directed tuft of white hairs on the vertex between the eyes. Antennae of female dark brown, with short, delicate, white pubescence. Each segment bears long, white hairs. The first 7–8 segments also bear 109 white scales which cover the whole segment, sometimes only part of it (apex, inner or outer surface). Antennae of male brown, with long golden hairs. Proboscis with light brown, adpressed scales; palps brown, with light brown scales, upright in the basal half of the palp, mainly adpressed in the apical half. All segments of palps with white rings at the apex; these rings are $^{1}/_{5}$ to $^{1}/_{4}$ as long as the segment, except on the last segment, on which the white ring is about $^{1}/_{2}$ as long as the segment. Mesonotum brown or grayish brown, densely covered with broad, white scales. The narrow stripes in the posterior half of the mesonotum and sometimes also the narrow stripes in the anterior half are the only parts without scales. Scutellum of the same color as the mesonotum and covered with white scales. Pleurae of thorax brownish gray, with grayish tomentum, densely covered with white scales, particularly in the middle. Legs brown, covered in a large part with white scales. Fore femora distinctly thickened in the basal third, covered with white scales often mixed with some brown scales. Fore tibiae covered with white scales; there are 2 sometimes fused, narrow, longitudinal stripes of brown scales on the outside. Fore tarsi blackish brown, with white rings at apex of the 1st, 2nd, 3rd and sometimes 4th segment; mid-femora anteriorly with brown scales mixed with white scales which sometimes form a longitudinal stripe, with white spots in the apical third and at the apex and with white scales posteriorly, with a white ring near the apex; tarsi of mid-legs brown, with white rings at the apex of the first 2–3 segments; hind femora like femora of mid-legs. Scales on hind tibiae mainly white; tarsi of hind legs with a pale brown 1st segment with a white ring at the apex. Second segment with a dark brown or blackish brown ring at the base, $^{1}/_{4}$– $^{1}/_{2}$ as long as the segment; apical part of 2nd segment and segments 3–5 white.

Wings with white scales in the greater part. There are usually 6 black spots at the anterior margin; the first two spots are in the basal fourth of the wing, are small and present only on the costa; the 3rd black spot is much longer (about $^{1}/_{2}$ as long as its distance from the base) and broad and extends to the subcosta and r_1; the 4th spot is 1.5 times as long as the 3rd, and extends to the subcosta, r_1 and also to the stem $r_{2+3} + r_{4+5}$; the last spot is sometimes covered with white scales in the part adjacent to the 4th spot. The 4th spot is often divided into three small spots with white scales on r_1. The 5th spot resembles the 3rd spot in form and distance from the apex and its distance from the base. The 6th spot is usually short and forms a curve toward the apex, occupying the costa, and r_1 and r_2. There are also more or less constant spots of dark scales in the basal third of one or both branches of the fork $r_2 + r_3$, in the middle third of r_3, in the basal third of the fork $m_1 + m_2$, and also in the apical parts of all longitudinal veins from
110 r_3 to anal vein. There are also less constant spots of dark scales in other parts of the wing, especially in the apical part of the stem $r_2 + r_3$ and $m_1 + m_2$ and on the anal vein, and in other parts. The fringe of the posterior margin consists in its apical half mainly of alternating parts of dark and white scales, only of white scales in the basal half. Halteres light, with dark brown head. Abdomen brownish black, with long, golden hairs on the posterior margin and at sides of tergites, covered nearly completely (except for a stripe at the anterior margin of the tergite) with broad, white scales. The white scales of the lateral parts of the abdomen sometimes have a golden or yellowish sheen. Posterior corners of tergites 2–7 with a tuft of projecting, white or yellowish brown scales. Abdomen dark brown ventrally, with white scales.

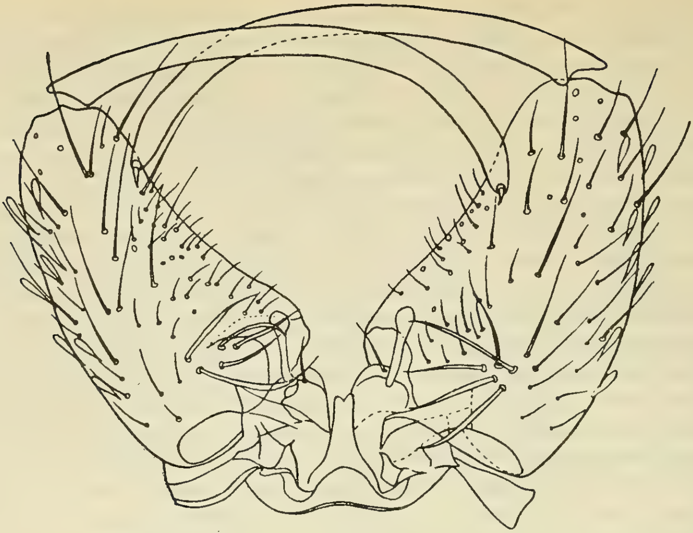

FIGURE 49. Hypopygium of Anopheles pulcherrimus Theob.

Hypopygium (Figure 49): coxite with 5 strong setae near the base on the inner side; claspettes with plates which are wider at the apex; aedeagus without leaf-shaped appendages.

Fourth-stage larva (Figure 50) 5–7 mm long, yellowish green. Inner clypeal hairs widely separated: distance between them twice the distance between the outer hairs and inner hairs. Inner clypeal hairs with 6–15 sparse, thin lateral branches from the basal third, so that they appear feathered. Outer hairs nearly half as long as inner hairs; they branch into 4–12 (average 7) thin branches, usually of the same length, from the middle or from the apical third. Postclypeal hairs half as long as the outer clypeal hairs, with 2–4 branches from near the base.

Hair No. 1 of metathorax well developed, palmate, with a long stem and 8–13 long, narrow leaflets without terminal filament, forming a fan and not
111 a rosette. Palmate hairs of abdominal segment 1 weakly developed and with 5–9 narrow leaflets without terminal filament, forming a fan. Leaflets distinct on segments 2–7, with 13–18 leaflets on the 2nd segment, with 18–23 leaflets on segments 3–6 and with 16–22 on segment 7. They are of uniform color except for the darker apex, which bears a long, pointed terminal filament with well defined, stepped denticles at the base.

Stigmal plate (Figure 51) very characteristic; anterior lobe irregularly dark; spiracles adjacent to anterior part of central plate, in the form of an arrowhead with distinct, posteriorly directed lateral processes the posterior margin of which forms a distinct concavity at the border with the middle part; medial part of central plate weakly pigmented and forming a striated, light medallion.

Eggs with lateral air floats and a broad, transversely striated fringe.

Distribution. USSR: plains and valleys of Middle Asia (Turkmenia, Uzbekistan, Tadzhikistan, southern Kirghizia, south of Kazakhstan (Syr-Darya valley)); not higher than 900–1,000 m in mountains. The species was formerly present in Azerbaidzhan, especially in the steppes in the lower reaches of the Kura River, Iran, Iraq, Afghanistan, Pakistan and India.

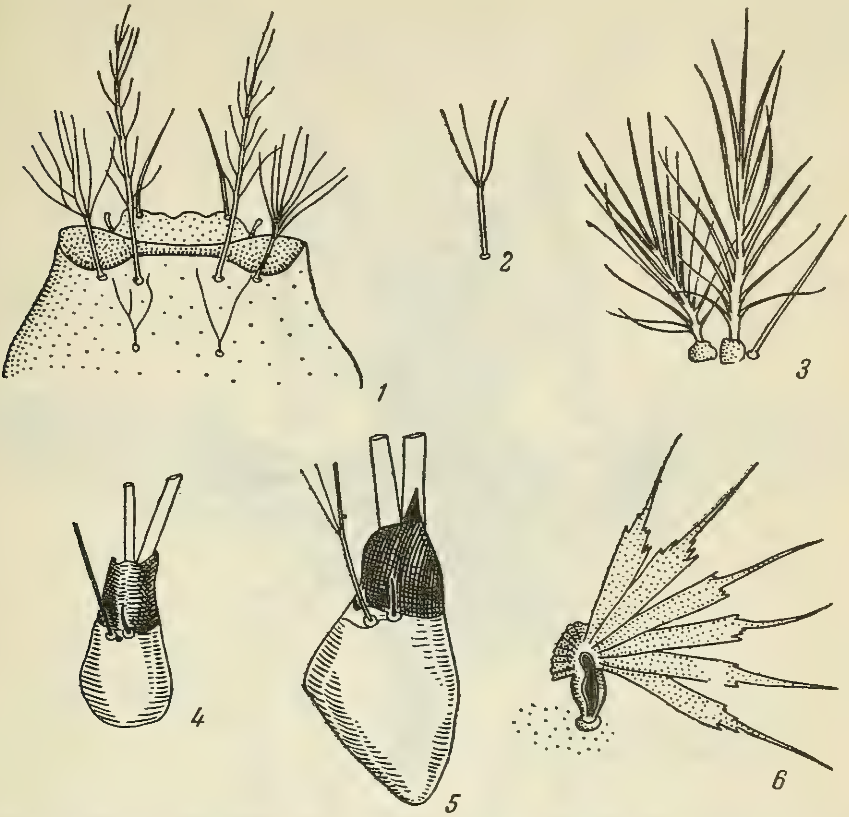

FIGURE 50. Anopheles pulcherrimus Theob. Fourth-stage larva (after Puri):

1 — anterior margin of frontoclypeus; 2 — variation of branching of outer clypeal hair; 3 — median hairs of prothorax; 4, 5 — base of lateral hairs of mesothorax and metathorax; 6 — palmate hair of 4th abdominal segment.

112 Biology. The larvae inhabit mainly shallow lakes, riparian forests and large swamps with rich aquatic vegetation, Potamogeton, Ceratophyllum, etc. floating on or near the surface. In contrast to larvae of other mosquitoes which occur mainly near the shore, A. pulcherrimus occurs mainly in the open parts where the dense thickets of Potamogeton replace the bottom. The larvae also are found in permanent pools, fed by underground water or by irrigation ditches in ponds, rarely in rice fields. They avoid small pools (less than 1–2 m^2) or water of high salinity. In the USSR, they hibernate as larvae of the middle stages (adults apparently hibernate in India); there is normally a high mortality in winter, so that the first generation is small. Their numbers increase in autumn.

A sharp fluctuation of the size of populations in the same locality in different years is characteristic for A. pulcherrimus. Especially damaging are unusually low temperatures in winter and a long cold spring. The mortality is very low in warm winters and springs, and numbers increase in summer. These fluctuations are often due to local factors.

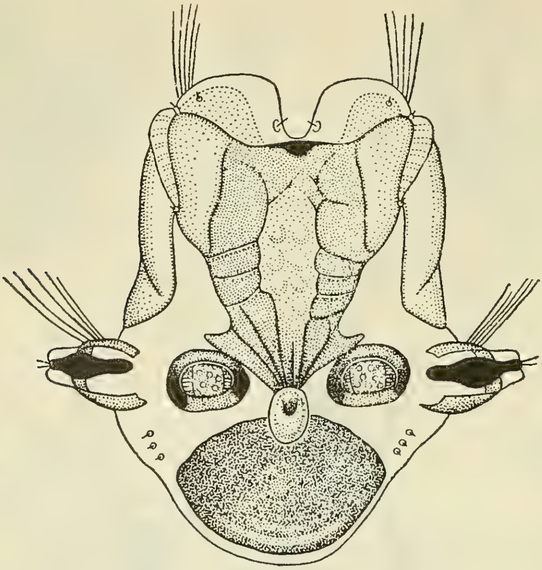

FIGURE 51. Anopheles pulcherrimus Theob. Stigmal plate of 4th-stage larva.

Females enter houses and cattle sheds. They also bite outside, mainly at dusk and in the night but there have also been mass attacks on man during the day. In contrast to the other species, A. pulcherrimus likes light and aridity.

It is usually considered as a minor vector of malaria. Experimental infection with tertian and tropical malaria was successful. Naturally infected mosquites have been found. In parts of Middle Asia, where A. pulcherrimus was common, it was considered as an important carrier of malaria, but its populations have now been reduced.

113 9. Anopheles (Myzomyia) superpictus Grassi, 1899 (Figure 52)

This is a very variable species, particularly in the color of the legs and wings. The hind tarsi are uniformly brown or have indistinct light rings.

114 Head with brown, upright scales laterally and upright white scales dorsally. Antennae with brown hairs; proboscis long, thin, with light apex; palps black, with distinct white rings and white apex; scales on palps adpressed. Mesonotum light brown, slightly darker laterally, with sparse,

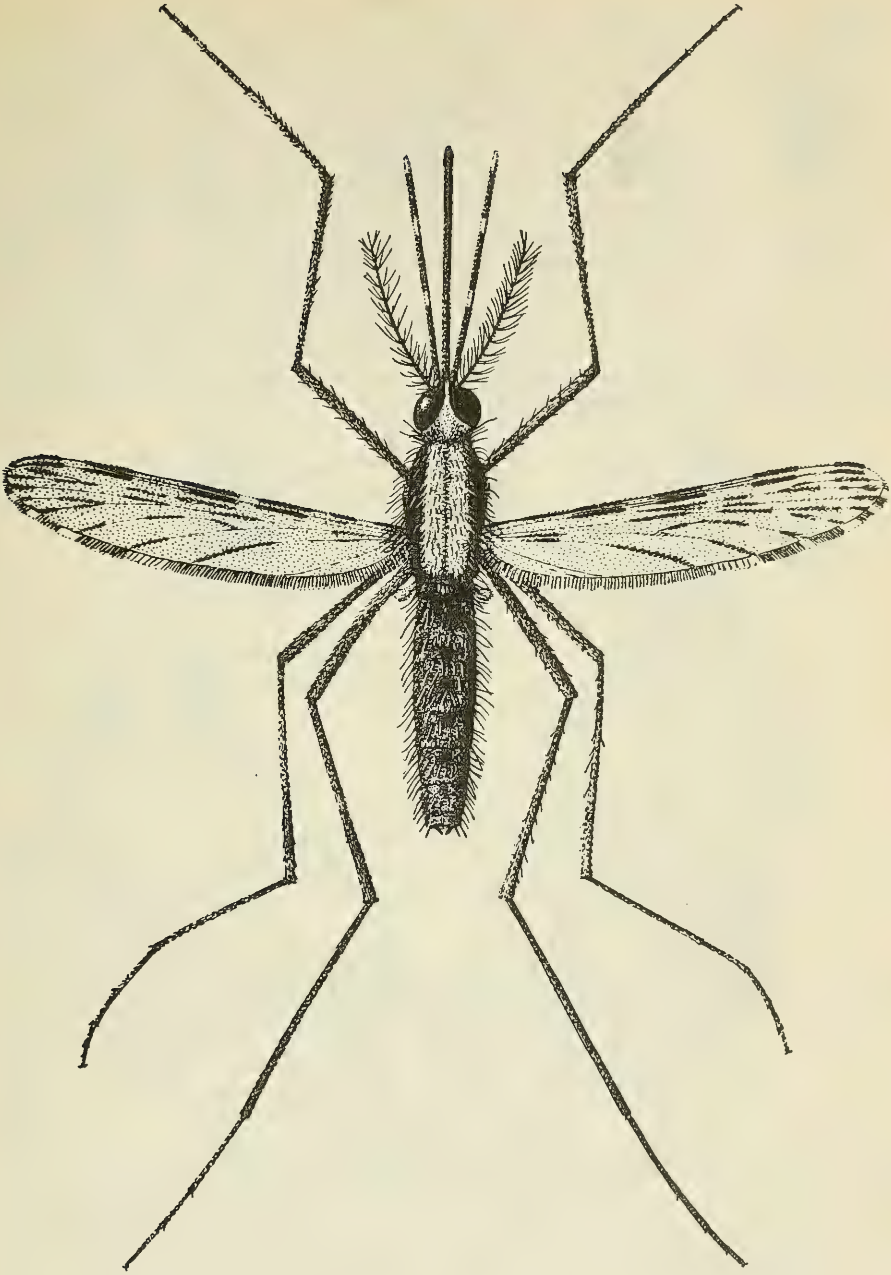

FIGURE 52. Anopheles superpictus Grassi

pale brown hairs and dense, narrow, whitish scales, especially in the anterior part; sides light brown, with a grayish tinge. Legs dark brown, coxae light, with white narrow rings at the knees, and at the articulations of tibiae and tarsi; tarsi mainly brown, rarely slightly ringed. Wings of markedly varying color; there are usually 4 spots of white scales at the anterior margin (the 4th spot at the apex of the wing in the male), and there are more or less numerous white scales in the basal part of the costa; the other parts of the anterior margin are covered with blackish brown scales; the light and dark spots of the anterior margin extend to the subcosta and r_1; the veins of the other parts of the wing (posterior to r_1) are mainly covered with white scales; more or less constant spots of dark scales are present on the stem of $r_2 + r_3$, in the basal part of $r_4 + r_5$, on the media (2 spots on the stem of $m_1 + m_2$ and one spot on each branch of the fork on m_{3+4}, and on the anal vein. Halteres brown, with dark head. Abdomen brown, with long, yellowish hairs.

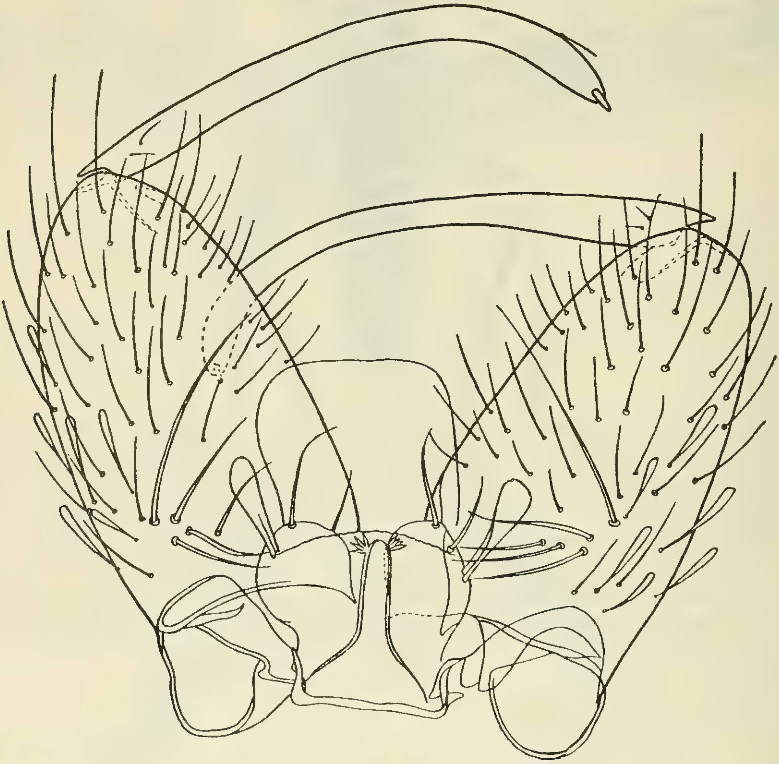

FIGURE 53. Hypopygium of Anopheles superpictus Grassi

115 Hypopygium (Figure 53): coxite relatively short and thick, with 5 strong setae at the base; claspettes with a plate which is widened at the apex; aedeagus with short, leaf-shaped appendages.

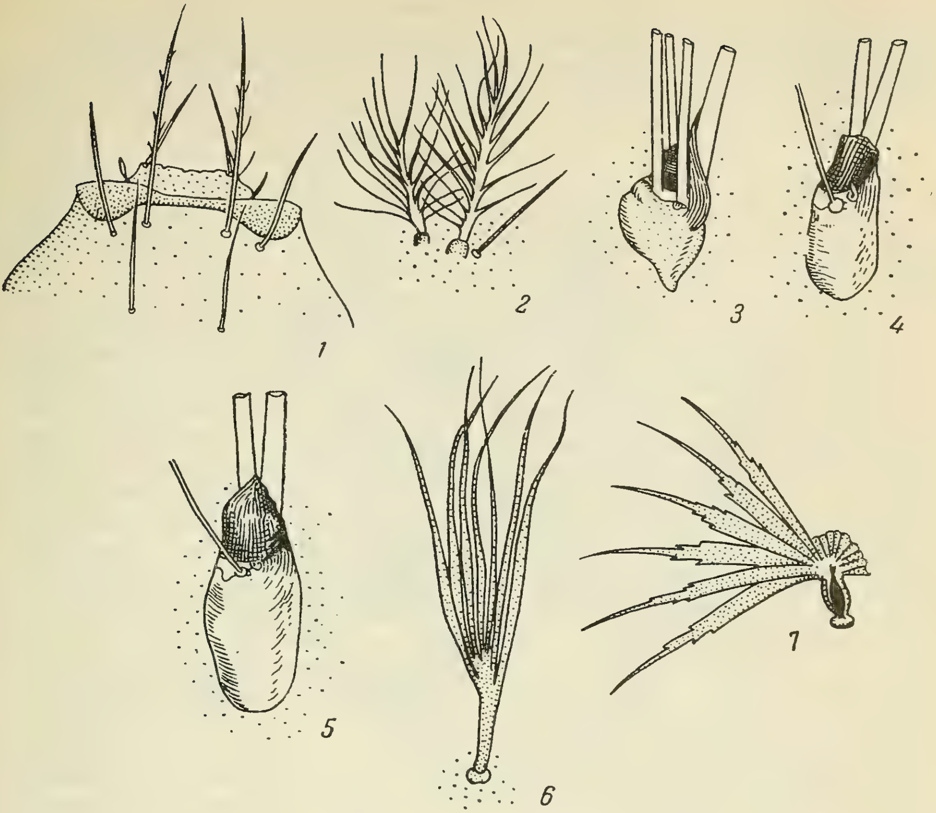

FIGURE 54. Anopheles superpictus Grassi. Fourth-stage larva (after Puri):

1 – anterior margin of frontoclypeus; 2 – median hairs of prothorax; 3–5 – base of lateral hair of prothorax, mesothorax and metathorax; 6 – palmate hair (No.1) of metathorax; 7 – palmate hair of 4th abdominal segment.

Fourth-stage larva (Figure 54) small, about 5 mm long, gray or grayish green. Inner clypeal hairs widely separated, the distance between them greater than the distance between the outer and inner hairs. Inner hairs thin, simple, with sparse secondary feathering, the outer hairs half as long, simple, smooth; postclypeal hairs simple, as long as the outer clypeal hairs.

Palmate hair on metathorax weakly developed, consisting of 6–8 thin, narrow, long, lanceolate leaflets, folded in a fan. Palmate hairs present on abdominal segments 2–7. On the 1st segment they have 5–7 thin branches often folded together; they have 12–15 leaflets on the 2nd segment, 14–18 on the third, 15–19 on segments 4–6 and 14–16 on segment 7. Leaflets with well developed terminal filament $^2\!/_3$ as long as the leaflet, striated and pointed, with narrow base and variable denticles.

116 Stigmal plate (Figure 55): anterior lobe dark but irregularly pigmented; spiracles adjacent to anterior part of central plate or connected with it by

processes; central plate broad, not tapering in anterior part of middle part the lateral margins of which are parallel; anterior part without lateral processes, forming an angle; granulation in middle of central plate weakly developed, diffuse but not forming a striated, light medallion.

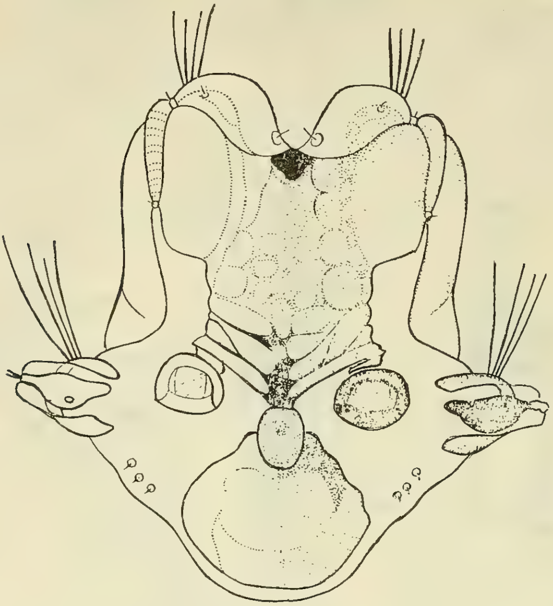

FIGURE 55. Anopheles superpictus Grassi. Stigmal plate of 4th-stage larva.

The eggs vary markedly, usually with a broad, transversely striated fringe but without air floats. Eggs deposited in the cold season, often with a few small air floats grouped more or less in an oval area on the flattened side at one end.

Distribution. This species is characteristic for the Mediterranean, where it is common in countries with a dry climate and is rare or absent where the humidity is high. Its distribution in the USSR includes Ciscaucasia (Dagestan), Transcaucasia (Georgia, Armenia, Azerbaidzhan), Middle Asia (Turkmenia, Uzbekistan, Tadzhikistan, Southern Kirghizia, southern Kazakhstan). Southern Europe: Spain, southern half of the Apennines, and Balkans. North Africa, from Algeria to Egypt. Asia Minor, Iraq, Iran, Afghanistan, Pakistan, northwest India.

Biology. The larvae inhabit flowing, slowly flowing or stagnant springs of ground origin (surface filtration) with waters transparent and well warmed water. They also occur in shallow pools in dry river beds (hoofmarks). In rapid currents they occur among algae between stones or at the bank. They have been found in rice fields with water of stream or ground

origin. The larvae have a high resistance to mineralization of the water and the salts in them, but avoid muddy water polluted by decomposition of organic substances with a high oxidation. They are very agile. At the slightest disturbance they descend to the bottom where they lie under
117 stones, etc. Stirring brings them to the surface. Fertilized females and only a few larvae hibernate.

Females usually remain active in winter; some of them suck blood during this time. The spring generation of larvae (usually in April in Middle Asia) is not large; the larvae develop relatively slowly. Development lasts 24 days at 21.5°, 10 days at 27°. The average duration of development is 12–13 days. Their numbers increase rapidly at the end of May and in early June (in Middle Asia) after the recession of floods and reach a maximum in the middle of summer (July in Middle Asia). The numbers decrease in August and increase again in the second half of September. This may sometimes be connected with the drainage of water from rice fields. During this time there is also an intensified flight of females into houses because of the colder nights. They begin to hibernate in October.

The females of A. superpictus feed on man and animals. They often enter houses during the day, between sunrise and dusk, and feed on the inhabitants. Many of them also enter cattle sheds during the day. They rest in dark corners, empty dishes, folds of clothes, etc. They also rest in tree holes, crevices in cliffs and clay structures, burrows of rodents (Citellus, Gerbillus, etc.), caves, etc. Activity reaches a peak at sunset and declines after nightfall.

The epidemiological importance of the species as a vector of all forms of malaria is very high. In many parts of Middle Asia it is a more important vector than other species of Anopheles because of its greatest numbers in the hot months (July–September), when the development of the plasmodia is very short. This is intensified by the anthropophilic character of the females and the rapid digestion which increases the need for blood more than in other species of Anopheles. There are also the ecological characters of the larvae that sustain high numbers of the species. In the Near and Middle East, A. superpictus is the most important vector of malaria.

II. Subfamily TOXORHYNCHITINAE

Large, brightly colored mosquitoes. The clypeus is wider than long. Proboscis thick, thinner in the apical half, usually curved downward. Maxillae and mandibles extending to about the middle of the proboscis, without denticles. Spiracular setae present, postspiracular setae absent. Scutellum uniformly curved. Wings with short radial fork (r_{2+3}); stem
118 of fork several times longer than fork, between m_{3+4} and cu_1 is a thickened membrane in the form of a narrow triangular plate; the posterior margin of the wing has a small incision at the apex of cu_1. Abdomen covered with broad scales and often with tufts of bright hairs at the end.

The larvae are large, about 20 mm long, dark wine red with a violet tinge; head rectangular, hairs weakly developed and situated mainly in

2 lateral groups in its anterior third. Antennae short, rod-shaped. Mouth parts predaceous. The lateral lobes of the labrum catch the prey; they consist of about 10 strong, hook-shaped, curved setae arranged in a row and serrated at the end. The mandibles have strongly developed denticles.

Thorax relatively narrow. A pair of tracheal air sacs on the main trunks of the trachea with hydrostatic function in its posterior part. Hairs of the body partly shortened and forming coarse spines with secondary spines. The lateral hairs are strongly developed, the dorsal hairs weakly developed because the larvae live under the surface film. At the base of the hairs and spines are strongly sclerotized plates, usually 3 pairs on each segment on each side in 3 longitudinal rows.

Larger plates are present on the sides of segment 8. On its dorsal side is a short siphon with a pair of hair tufts at its base; auricles and pecten absent. The short, posterior segment is surrounded by a chitinized ring with spines at the posterior margin.

Biology. The larvae inhabit small accumulations of water in the axils of leaves of Bromeliaceae and in bamboo and tree holes, feeding on larvae of other mosquitoes. They are predaceous, killing even each other. They are used to kill the larvae of other mosquitoes in tree holes on tropical islands.

The females deposit the eggs singly on the surface of the water. They are mainly found at the upper border of forests, where they feed on nectar and do not suck blood.

The subfamily contains only one genus with three subgenera.

2. Genus Toxorhynchites Theobald
(Megarhinus Ronineau-Desvoidy)*

With the characters of the subfamily.

This is a tropical genus; only a few species occur in the southern temperate zone. Over 50 species have been described. The subgenera Ankylorhynchus and Lynchiella occur in the tropics of the western hemisphere while the species of the subgenus Toxorhynchites are mainly distributed in the Oriental region. The Palaearctic species are related to the Oriental group.

1. Toxorhynchites christophi Portschinsky, 1884
(?towadensis Matsumura, 1916) (Figure 56)

119 These are large mosquitoes, 10–13 mm long without the proboscis. Nearly all scales are contiguous, with a green, blue, violet or silvery white metallic sheen.

Female. Occiput with broad, dark brown scales with a blue metallic sheen. Posterior margin of eyes with bluish white scales. Proboscis very long ($^{2}/_{3}-^{3}/_{4}$ as long as the body), curved downward, with dark brown scales with a steely sheen. There is an indistinct ring of lighter scales in the middle of the proboscis and long, black hairs at its base. Palps short with blackish brown scales with a metallic sheen. Antennae brown, torus with white scales.

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* The name Megarhinus is now considered as a synonym of the subgenus Lynchiella.

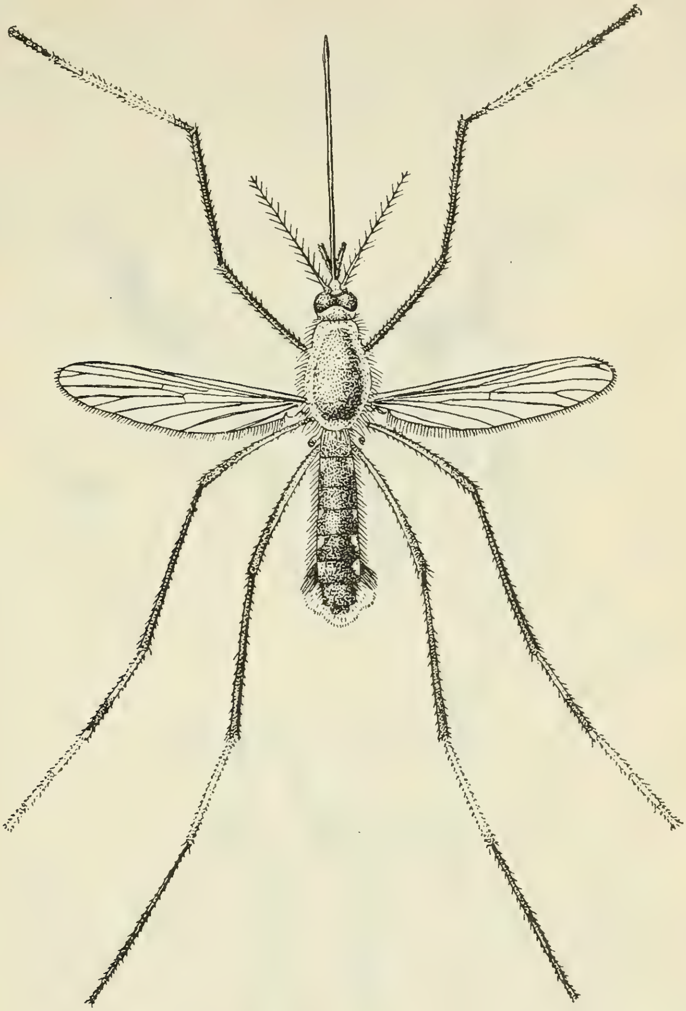

FIGURE 56. Toxorhynchites christophi Portsch.

Mesonotum with reddish brown, narrow scales, the anterior margin and
lateral parts with broader, pale blue scales; above the base of the wings
120 are tufts of yellow hairs. The pleurae are covered with broad, white, shining
silvery scales in their greater part. Scutellum with shiny, broad scales,
greenish in the middle and golden laterally, the golden scales more numerous.
The setae on the margin of the scutellum form a complete row.

Legs: femora and tibiae with black, steel-colored scales. Basal part of femora with white scales ventrally. Apical half of 1st segment, the whole 2nd segment, sometimes also base of 3rd segment of fore tarsus, base (sometimes also apex) of 1st and other segments of the mid-tarsus, and 2nd segment of hind tarsus white. The other tarsal segments are black with a blue sheen. Claws simple.

Wings transparent, slightly dark; veins with brown scales. Cross-vein between r_{2+3} and r_{4+5} situated more distally than cross-vein r—m, which is situated in a line with the cross-vein m—cu.

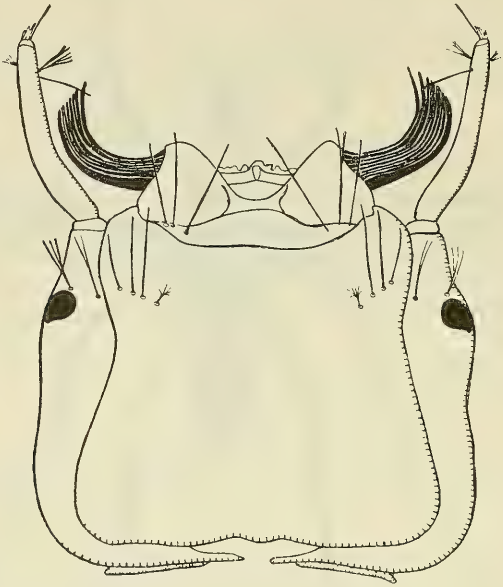

FIGURE 57. Toxorhynchites christophi Portsch.
Fourth-stage larva. Head, dorsal.

Abdomen covered with black scales, with a greenish, metallic sheen in the anterior half and with a bluish sheen in the posterior half. In the anterior half of the 5th (and sometimes also the third) tergite is a more or less distinct transverse stripe of white scales; sides of tergites also white. Fifth tergite with white stripes laterally, 6th tergite with tufts of longer, dense black hairs, tergites 7 and 8 with tufts of bright orange-yellow hairs.

Male. (We have no males in the collection and give the description of the male of T. towadensis after La Casse and Yamaguti, 1955.) Palps slightly shorter than proboscis, with dark scales and with 2 light rings; apex of palps curved dorsally, pointed. Coloration as in the female. Tergites 6 and 7 with thick tufts of dark hairs laterally, tergite 8 with tufts of golden brown hairs.

There is no description of the hypopygium.

Fourth-stage larva (Figure 57) about 16–20 mm long, wine-red-violet, resembling that of T. splendens Wied.

Head rectangular, with rounded corners, frontoclypeus distinctly concave laterally behind the eyes. Anterolateral corners of frontoclypeus projecting anteriorly, anterior margin concave. Clypeus strongly developed, especially its lateral parts with the lateral lobes of the labrum, which catch the prey. Each lobe bears 10 thick, curved, dark hooklike setae with 2–3 short denticles at the end. The other mouthparts are situated at the anterior margin, so that the gular region is very large. Mandibles with 2 large and 3–4 smaller denticles at the end. Antennae short, less than half
121 as long as the head, their ends at the level of the ends of the setae of the labrum when extended anteriorly. Antennae without spines. Three hairs at the terminal quarter, one of them, the one farthest from the apex, simple and directed inward, the other two shorter and branched.

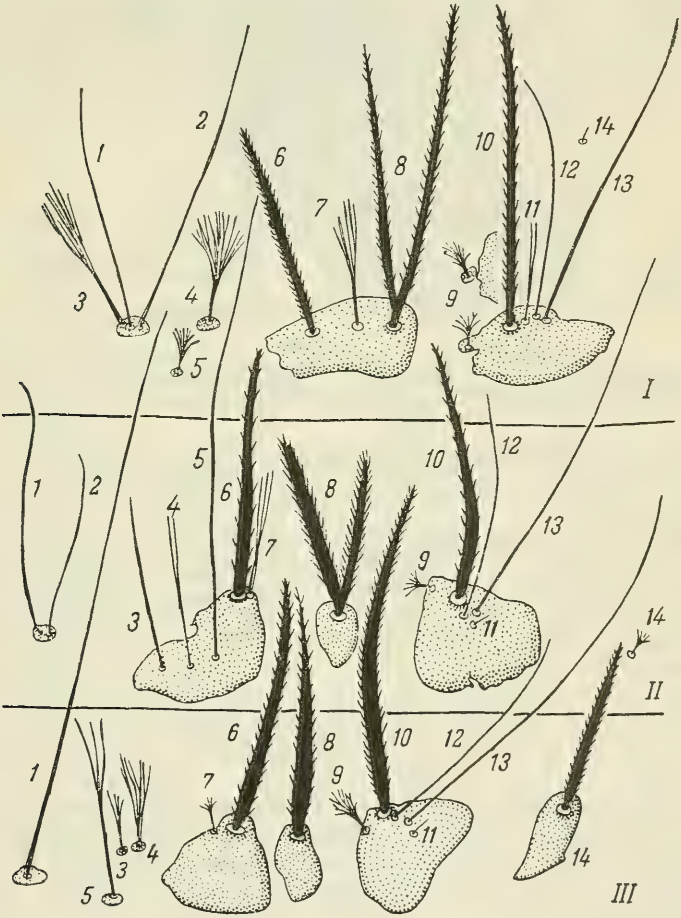

FIGURE 58. Toxorhynchites christophi Portsch. Fourth-stage larva. Chaetotaxy of thorax (shown in a plane). Roman numerals designate thoracic segments, Arabic numerals numbers of hairs.

Clypeus with three simple hairs on each side, the groups widely separated. The two outer pairs correspond to the clypeal hairs of larvae of Anopheles and the longer inner hairs to the median frontal hairs. There are four pairs of hairs on the frontoclypeus in the anterior third which form two lateral rows. The two middle pairs are simple and the longer hairs correspond to the outer and inner frontal hairs, the shortest branched inner pair corresponds to the postclypeal hairs and the outer pair to the sutural hairs; near these and lateral to the frontal suture are 2 branched, transsutural hairs.

123 The hairs on the body vary in structure; there are 3 types: 1) large spines, with coarse secondary feathering, simple or 2-branched; 2) long, thin, smooth and simple hairs, sometimes slightly branched at the end; 3) short hairs, simple or slightly branched some distance from the base. The groups of hairs are situated on sclerotized plates.

Each thoracic segment bears 14 pairs of hairs which form several groups in 3 transverse stripes in several longitudinal rows: dorsal, dorsolateral, lateral, ventrolateral and ventral (Figure 58). The arrangement of the hairs and chitinized plates on the abdominal segments is shown in Figures 59 and 60.

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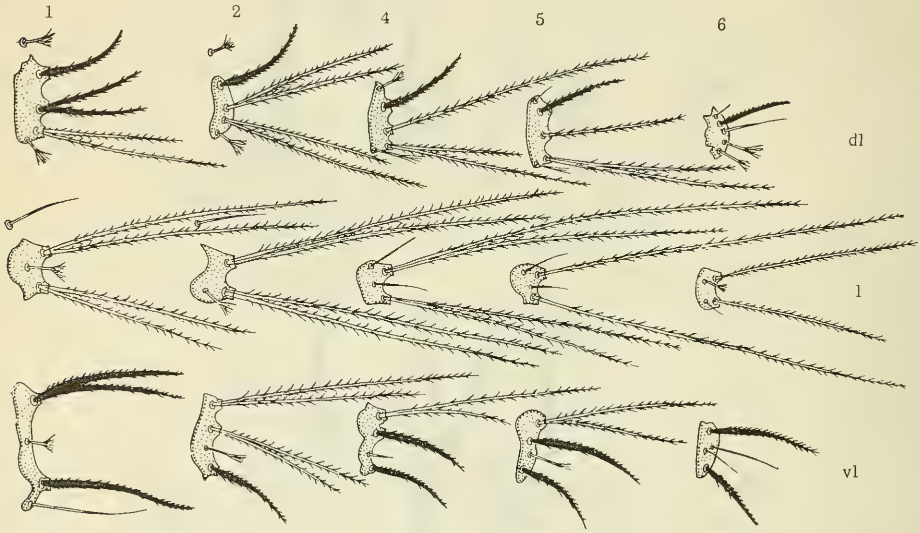

FIGURE 59. Toxorhynchites christophi Portsch. Fourth-stage larva. Chaetotaxy of abdominal segments 1, 2, 4–6. Rows of dorsolateral (dl), lateral (l) and ventrolateral (vl) hairs of left side.

At the sides of the 8th segment are large plates and at their posterior margin are two long, secondarily feathered setae and above them two thin, short hairs and below the base of the siphon a longer, thin hair. These five pairs of setae and hairs correspond to the hairs behind the comb of larvae of Culicinae. A comb is absent. Siphon short, in the form of a truncate cone. It is slightly longer than wide at the base. Auricles and pecten absent. Two short hairs with 5–6 secondarily feathered branches situated on the posterolateral side of the siphon near the base.

122)

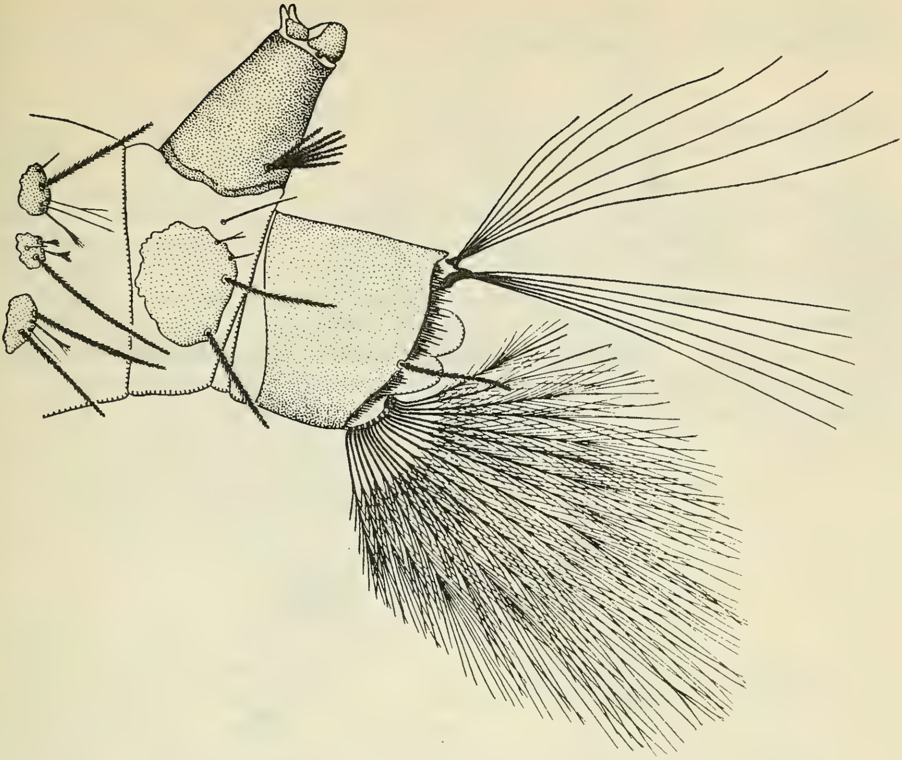

FIGURE 60. Toxorhynchites christophi Portsch. Fourth-stage larva. Posterior end, lateral.

Last segment short and broad. The saddle surrounds it completely and has a row of closely situated spines of different length on the sides of the posterior margin. The lateral hair has the form of a spine and is shorter than the segment. The outer and inner caudal hairs have 6–7 branches. The outer hairs are slightly longer than the inner. The fin is situated posteriorly, with 18–20 long, secondarily feathered hairs which form an asymmetrical fan. Gills short, spherical.

Biology. The larvae live in water in the holes of elm and linden trees. They are found from the end of June to late August or early September. Remains of larvae of A. (St.) galloisi Yam. and A. (F.) alektorovi were found in the intestine. Very rare.

Note on systematics. Shtakel'berg (1937) stated that T. towadensis Mats. is apparently a synonym of T. christophi. There are no distinct differences between them. However, the description of T. towadensis (La Casse and Yamaguti, 1955) mentions golden brown hairs on abdominal segment 8 of the female, and does not mention the bright hairs on tergites 5–7. These tufts of hairs, white, black and yellow, give the insect its characteristic appearance. They may have been lost on the specimen of M. towadensis described.

Distribution. Southern Maritime Territory (Alektorov, 1931; Monchadskii, 1951). Japan (Honshu).

2. Toxorhynchites sp. (Figures 61, 62)

Only the larvae are known.

The 4th-stage larva resembles that of T. christophi but differs as follows: 1) head wider; 2) spines on the body more strongly developed; simple spine number 8 on lateral plate of mesothorax not 2-branched;
125 siphon nearly cylindrical, not truncate-conical; tuft of hairs on siphon longer than width of siphon at its position; lateral spine on saddle longer than last segment; ends of caudal hairs slightly curved upward, the outer hairs weakly branched; fin with about 15 hairs on which the secondary feathering begins at the base; gills larger, oval.

(124)

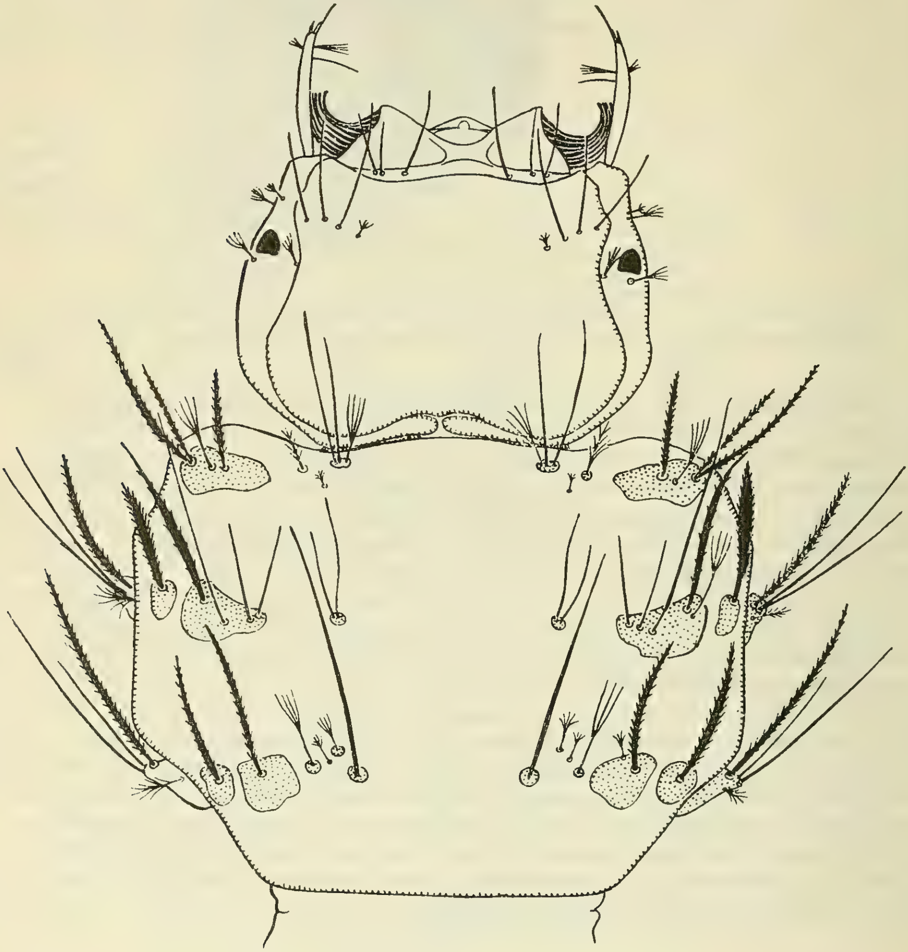

FIGURE 61. Toxorhynchites sp. Fourth-stage larva. Anterior end, dorsal.

(124)

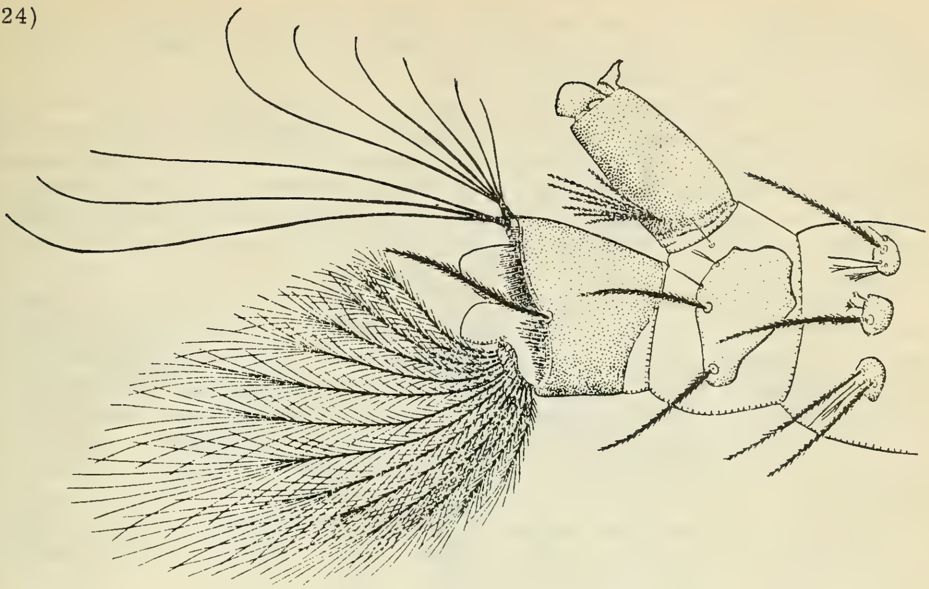

FIGURE 62. Toxorhynchites sp. Fourth-stage larva. Posterior end, lateral.

Biology. The larvae were found in water in holes of trunks of Korean pine and in root holes of maple in July and August together with larvae of A. (St.) galloisi, A. (F.) alektorovi and A. (F.) nipponicus.

Distribution. Southern Maritime Territory, Barabash area, "Kedrovaya pad'" Reserve (Monchadskii, 1940; Amosova, 1951).

III. Subfamily CULICINAE

Clypeus longer than wide, its anterior margin rounded. Proboscis thin, rarely slightly thicker apically, not curved; mandibles and maxillae of females long, rarely (some exotic species) extending to end of labium, with denticles in the apical part. Mesonotum distinctly convex. Scutellum distinctly 3-lobed, with 3 tufts of setalike hairs; space between lobes bare. Wings with long radial fork, which is rarely shorter than its stem; thickened plate between m_{3+4} and cu_1 absent. Abdomen with scales, which are usually contiguous. Hypopygium of varying structure; anal segment always with well developed sternite; aedeagus without leaf-shaped appendages. Females usually with 3 spermathecae.

The head of the larva is often wide, rarely rounded or oblong, not rotating through 180°. Frontoclypeus with 3 pairs of frontal hairs in its anterior part, arranged in a curved row or forming 2 symmetrical triangles, and a pair of postclypeal hairs which are branched in a fan but are not feathered. Antennae of varying form and length; they are longer in larvae with the filtration type of feeding and shorter, rod-shaped with different types of hairs and sensory setae at the end in larvae feeding on periphyton and on predators. The mouth parts differ according to the type of feeding.

Hairs of the body branched or fan-shaped, situated in one plane or palmate: their branches arranged like the ribs of a polyhedral pyramid; the branches may be secondarily feathered.

Thorax broad, without shoulder organs. Abdomen without palmate hairs. Abdominal segment 8 with a varying number of scales at the sides forming the comb behind which are 5 hairs. At the posterior margin of the dorsal side of segment 8 is the siphon with a pecten and from 1 to 5–6 pairs of variously arranged hair tufts. The last segment, bears the saddle, which sometimes forms a complete ring, and two pairs of caudal hairs and one pair of lateral hairs. Fin present, rarely absent.

The large subfamily Culicinae has been divided into a different number of tribes (2–12). Dodge,(1962) suggests dividing the subfamily into four tribes: Sabethini, Aedini, Uranotaeniini, Culicini. We prefer the simpler 126 classification of Stone et al. (1959), in which the subfamily Culicinae is divided into the tribe Sabethini with 8 genera (tropics of both hemispheres, mainly in South America) and the tribe Culicini with 19 genera. Eight genera of Culicini occur in the Palaearctic: Uranotaenia, Culiseta, Orthopodomyia, Mansonia, Aedes, Culex, Heizmannia and Armigeres. The first six genera occur in the USSR. Only one species of Tripteroides, T. bambusa Yam. (Rachionotomyia bambusa) occurs in the Palaearctic in Japan and China.

3. Genus Uranotaenia Arribalzaga

Small, dark species. Eyes contiguous in dorsal part of head above the antennae and ventrally (behind the proboscis). Palps of both sexes short, usually not longer than $^1/_6$ of the length of the proboscis. Mesonotum with well developed acrostichal and dorsocentral setae. Lobes of pronotum widely separated, usually with 3 setae; one spiracular seta which is rarely absent (in some exotic species); postspiracular setae absent; there are also 2 prealar, several upper sternopleural, usually 2 upper mesepimeral and one lower mesepimeral setae. Legs slightly widening at base of mid-femora rarely also fore femora. Tibiae and tarsi of males of many exotic forms with distinct secondary sexual characters. Claws of both sexes simple, without denticles, pulvilli absent. Microtrichia very small, wings appearing bare without high magnification; forks short, fork m_{1+2} distinctly shorter than its stem. Anal vein ending in posterior margin at level or before base of stem of r_{2+3} and r_{4+5}; postalar sclerites without scales. Abdomen short, with blunt apex in females. Hypopygium with a short coxite with a moderately large basal lobe which is covered with setae. Style simple, with an apical appendage; anal segment membranous, without sclerotized denticles; phallosome divided into plates, sometimes with denticles.

Larvae small, with dark, slightly oblong head and short antennae. At the sides of abdominal segment 8 are chitinized plates with a row of a few spines at the posterior margin. Denticles of pecten of siphon with fringed margin, not pointed. One pair of hair tufts near middle of the siphon. The larvae keep horizontal under the surface of the water.

The genus contains about 140 species, most of them in the tropics of both hemispheres. It is represented in the Palaearctic by one species in

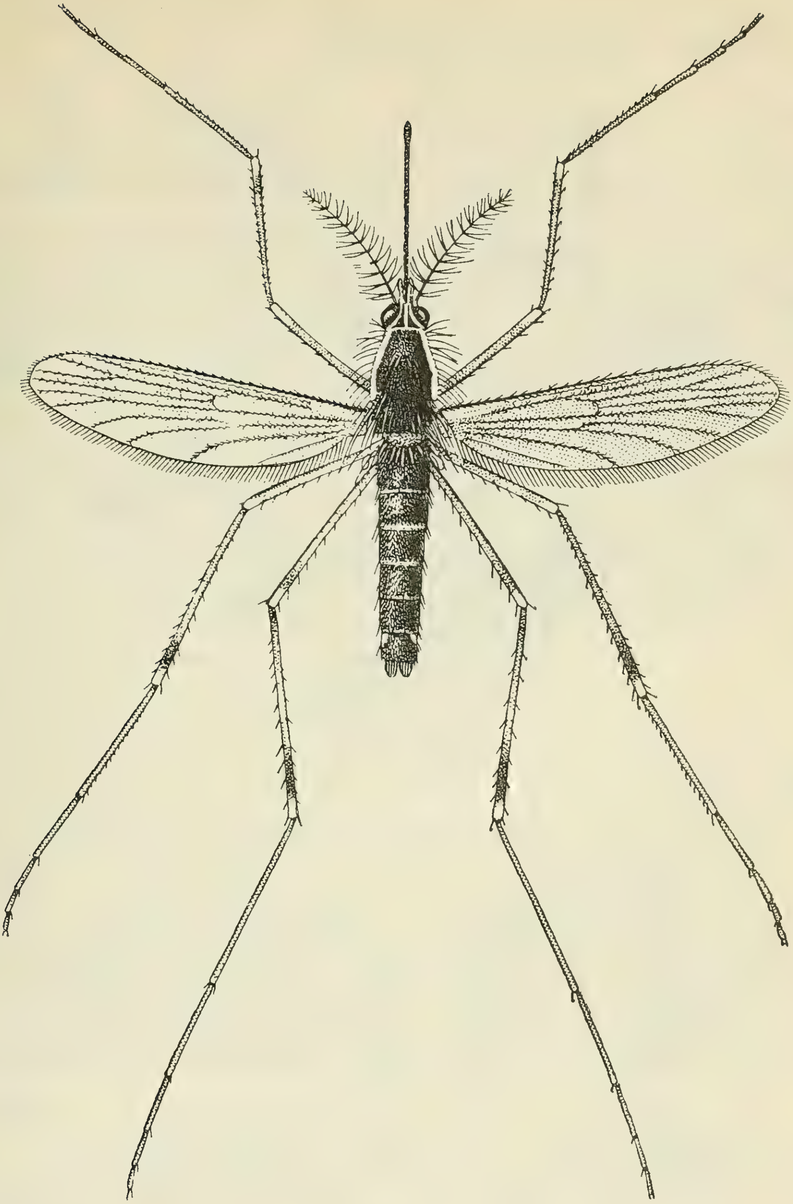

FIGURE 63. Uranotaenia unguiculata Edw.

the Mediterranean area in the wide sense (including the Caucasus and Middle Asia) and by one Oriental species in Japan.

1. **Uranotaenia unguiculata** Edwards, 1913 (Figure 63)

Small mosquitoes with narrow, silvery stripes at sides of mesonotum and on the pleurae. General color dark brown.

Head covered with dark brown scales in its greater part, usually with a longitudinal stripe of silvery scales dorsally. Proboscis and palps of both
127 sexes blackish brown. Palps short in both sexes. Antennae and antennal hairs brown in both sexes. Basal segments of antennae with silvery scales. Mesonotum with dark brown scales, sometimes with a reddish tinge, and with a narrow longitudinal stripe of silvery scales at the sides from the anterior margin to the base of the wings. Scutellum with brown scales; pleurae with a longitudinal stripe of silvery scales in the middle. Legs: coxae of fore and mid-legs with silvery scales; femora with brown scales anteriorly, usually with a sharply defined longitudinal stripe of white scales
128 which is complete on the fore and mid-legs and fused with the white scales on the posterior surface on the hind legs; posterior surface of fore and mid-femora also with white scales; tibiae anteriorly with blackish brown scales, often with a diffuse white spot in the middle; tibiae with white scales posteriorly; apex of femora and tibiae with white scales; tarsi black; claws of fore tarsus of male with one denticle. Wings transparent, slightly grayish, veins covered with broad, brown scales; stem of radial veins with white scales in the basal part. Abdomen with dark brown scales dorsally, with triangular spots of silvery scales at the sides, sometimes only on the last tergites, with white scales ventrally.

Hypopygium (Figure 64): coxite thick and short, irregularly conical, with a small, flat lobe with 3 setae on the inside in the basal third; style broad, slightly tapering in the basal third, with a spine-shaped appendage at the apex.

Fourth-stage larva (Figure 65) small, yellowish green or yellowish brown, with dark head.

Head oblong. Mouth parts situated anteriorly, so that the gula is 1.5–2 times as large as in larvae of other genera and the base of the labrum is situated more anteriorly. This is connected with the feeding on the lower side of the surface film and bending the head posteriorly when the body is horizontal.

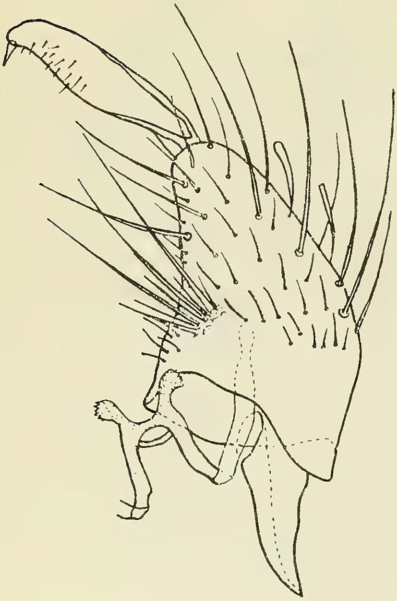

FIGURE 64. Hypopygium of Uranotaenia unguiculata Edw.

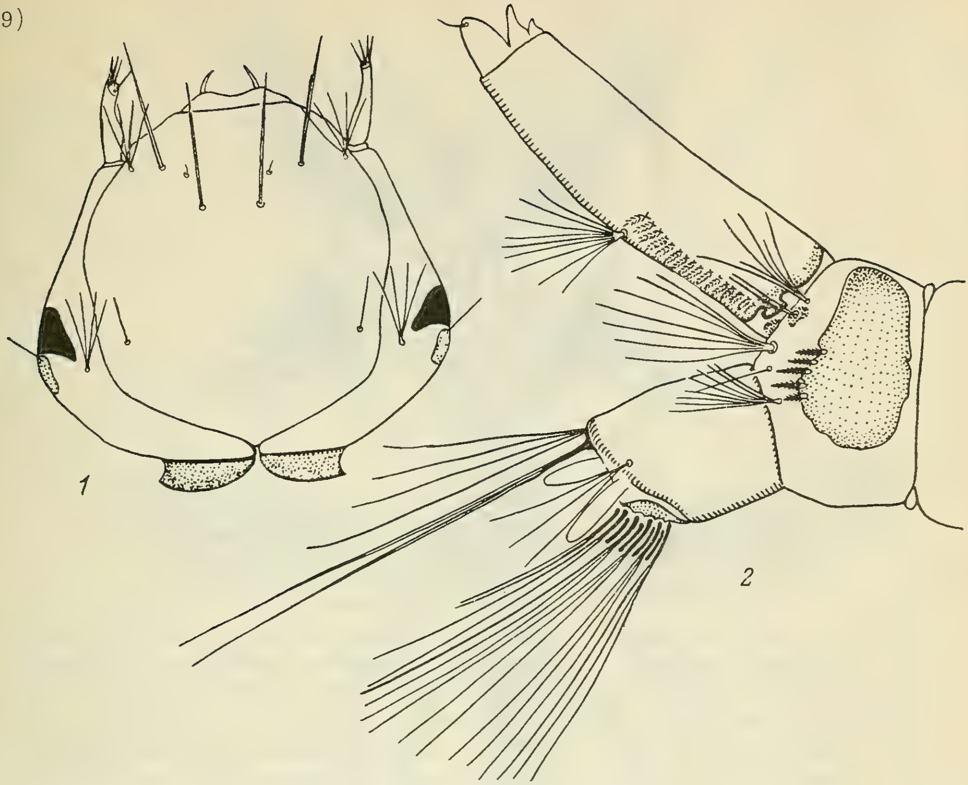

FIGURE 65. Uranotaenia unguiculata Edw. Fourth-stage larva:

1 — head, dorsal; 2 — posterior end, lateral.

Outer frontal hairs with 4—7 short branches, median hairs longer, simple, thick. The inner hairs are situated behind the median hairs, close together, simple, rarely with 2—3 branches. Postclypeal hairs short, simple or slightly branched, situated before the inner frontal hairs. Antennae short, straight, slightly tapering apically, dark, almost or completely without spines. Hair of antenna thin, short, situated in the middle of the dorsal surface.

Abdomen: segment 8 with a chitinized plate at the sides, the upper margin of which may extend to the dorsal side. Plates indistinct in recently molted larvae, darker toward the end of the stage. In the ventral part of the posterior margin are the spines of the comb in a row of 5—8, usually 6, dark, conical, pointed spines which are covered with thin, very short hairs in a row.

Siphon with well developed auricles at the base, moderately long (index 3.2—3.8, usually 3.5—3.6), with straight anterior side, slightly tapering apically. Pecten with 13—18 (usually 15—16) weakly pigmented denticles
129 which are regularly spaced (except the 2—4 basal denticles). Each denticle forms a scale with short, thin spines at the margin. One pair of hairs with 8—12 secondarily feathered branches in the middle of the siphon near the distal denticles of the pecten.

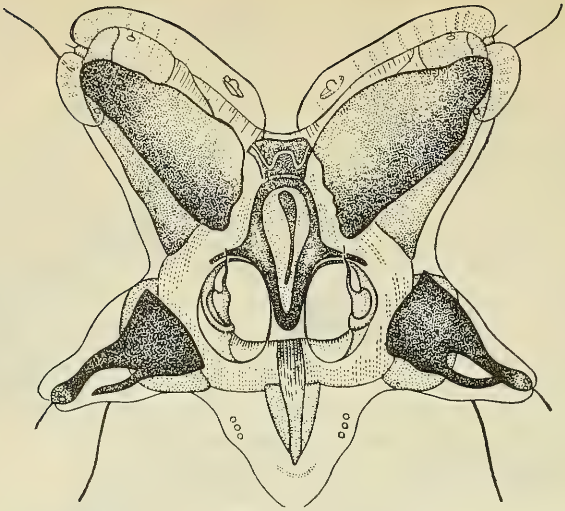

FIGURE 66. *Uranotaenia unguiculata* Edw. Fourth-stage larva. Stigmal plate.

The stigmal plate (Figure 66) has a posterior process of the "stirrup," which ends in two pointed clawlike, inward directed appendages, and a thick, lateral margin of the spiracles and a slightly twisted, anteriorly directed hair of the chaetoid type with a wide base.

The last segment is surrounded by a dark chitinized ring with a thin,
3-branched lateral hair. Outer caudal hairs 2-branched, one hair as long
130 as the siphon, the inner hairs with 4 shorter branches. Fin with about 10
tufts. Gills lanceolate, with rounded end, much shorter than the last
segment.

Distribution. Mediterranean. USSR: southern Ukraine, Volga delta, Caucasus, Middle Asia, to the basin of the Ili River in the Alma-Ata Region in the northeast; Southern Europe, North Africa, Southwest Asia, Iran, Pakistan.

Biology. The larvae are found in shaded parts of small, stagnant pools overgrown with vegetation (sometimes *Lemna*). They prefer fresh or nearly fresh water and avoid water with a salinity higher than 0.1–0.2‰. They are found together with larvae of *Anopheles maculipennis sacharovi*, *A. hyrcanus*, *Culex pipiens* and *Aedes caspius caspius*. They rarely bite man.

4. Genus *Orthopodomyia* Theobald

The genus is characterized by the absence of pulvilli and the presence of spiracular setae. Two proepimeral setae. First segment of fore tarsi longer than the other segments. Large insects, mainly black with a white pattern.

(131)

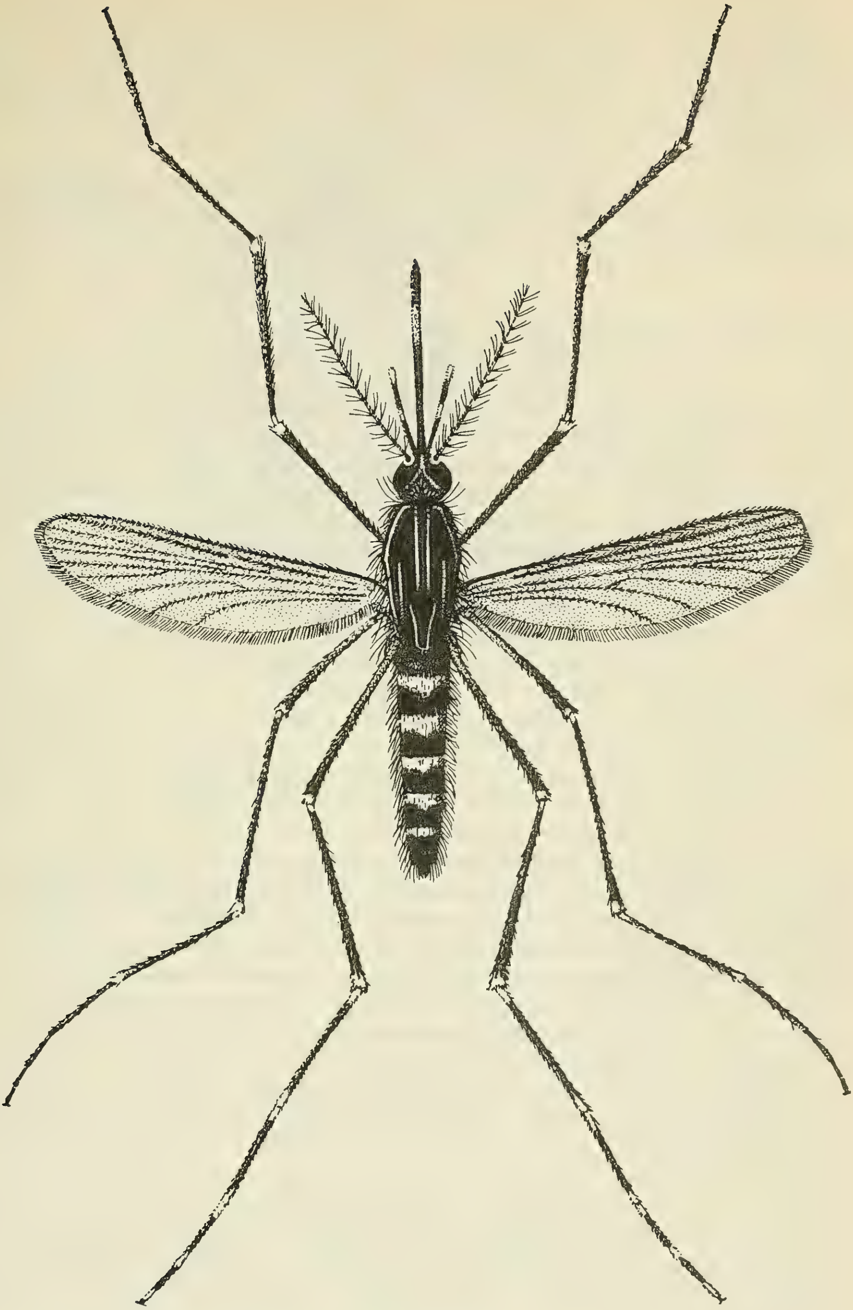

FIGURE 67. Orthopodomyia pulchripalpis Rond.

The larvae are reddish or pinkish and become bluish violet before pupation; the hairs of the thorax and abdomen are very long, particularly the lateral hairs. There are plates on abdominal segments 6–8, a pecten on the siphon is absent, and the comb consists of 2 straight rows of long scales of characteristic form. The main tracheal trunks are widened in the metathorax The larvae develop in tree holes.

This is a small genus with about 20 species in the Oriental region and in the southern part of North America and in Central and South America. One Mediterranean species in the Palaearctic.

1. Orthopodomyia pulchripalpis Rondani, 1872
(albionensis MacGregor, 1919)

This species differs from all other Palaearctic mosquitoes in the characteristic pattern on the mesonotum (Figure 67).

Head black, with black scales mixed with white scales. Posterior margin of eyes with white scales dorsally. Proboscis with black scales and with a more or less broad white ring near the middle. Palps of male distinctly longer than proboscis, black, with white rings at the articulations and with white terminal segment. Palps of female nearly half as long as the proboscis, black, with a white ring in the middle and with white apex. Antennae black, basal segment with white scales. Mesonotum black, with narrow black scales and with narrow, white longitudinal stripes; the 2 median stripes extend from the anterior margin to the scutellum, parallel in the anterior half, slightly curved in the posterior half; the two lateral stripes are present only in the posterior half above the base of the wings; lateral margin of mesonotum with a narrow white stripe. Legs with black 132 scales with a steel sheen; base of femora with yellowish white scales; dorsal surface of femora with speckles of white scales; tibiae with a white spot; tarsi black with white rings covering the apex of the preceding segment and the base of the following segment; white rings on fore and midtarsi weakly developed, present usually only on the basal segments; white rings distinct on all segments of the hind tarsi; segment 5 of hind tarsi white. Wings transparent; veins with brown scales, base of stem of radial veins with silvery white scales. Abdomen blackish brown, covered with scales of the same color, with moderately broad transverse stripes of white scales at the anterior margin of the tergites.

Hypopygium (Figure 68): coxite with a conical lobe near the base; lobe with 4–5 large setae; style relatively narrow, slightly thicker in the basal half, with an appendage about as long as the width of the style in its widest part at the apex.

Fourth-stage larva (Figure 69) reddish, becoming violet before pupation. Head dark, rounded. Frontal hairs long, with secondary feathering; outer hairs shorter than the others, median hairs (9–10-branched) and inner hairs (5–7-branched) reaching far beyond the anterior margin of the head. Slightly before and between the inner frontal hairs are the postclypeal hairs, which resemble the outer frontal hairs in length and branching. Antennae straight, without spines. A hair with 7 short branches forming a fan at $^{1}/_{3}$ of the length from the base. Mouth parts transitional to the filtration type of feeding.

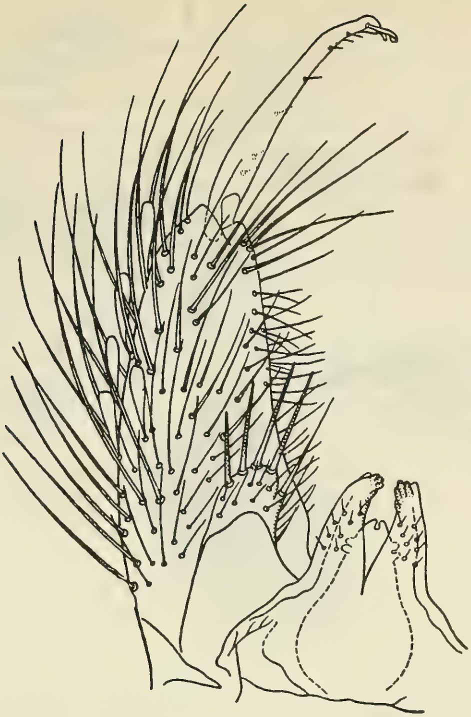

FIGURE 68. Hypopygium of Orthopodomyia pulchripalpis Rond.

Thorax wide, especially posteriorly, with very long lateral hairs. Abdominal segments distinctly narrower posteriorly Lateral hairs also very long. In older larvae, there are dark plates on the dorsal side of segments 6–8. The plates are small and narrow on segment 6, extend to the sides on segment 7, are narrower but also extend to the sides on segment 8. There are also narrow lateral plates between the 8th and last segment.

Siphon (index 3.5–4) without a pecten and auricles. There is a hair with 8–10 branches forming a fan on the posterior surface near the middle.
133 The comb consists of two rows of long denticles with a pointed spine; some denticles of the posterior row (16–20) are situated between the denticles of the anterior row (7–10). Only the median hair of the hairs behind the comb is strongly developed, resembling the hair on the siphon.

The last abdominal segment has a ring-shaped saddle, its ventral margin much shorter than the dorsal-margin. Outer caudal hairs nearly as long as the abdomen, simple, inner caudal hairs forming a short, asymmetrical fan with 9–14 branches. Fin with 14 tufts. Gills lanceolate; dorsal pair as long as the saddle, ventral pair half as long.

Distribution. Mainly Mediterranean. USSR: southern coast of the Crimea, Transcaucasia from Sochi to Lenkoran'. Southern Europe, North Africa (Algeria, Tunisia), Turkey. It extends to Belgium and the south of England in the north.

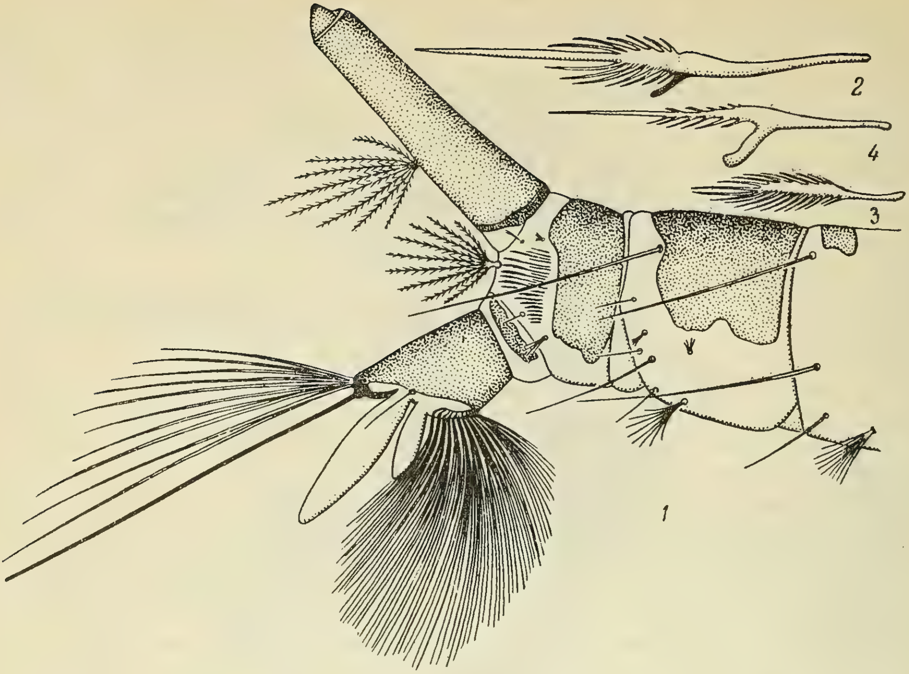

FIGURE 69. Orthopodomyia pulchripalpis Rond. Fourth-stage larva:
1 – posterior end, lateral; 2–4 – scales of comb (2 – large, 3 – small, 4 – lateral).

Biology. The larvae breed in water in tree holes (beech, horse chestnut, and others) or below the roots, often together with larvae of Anopheles plumbeus, Aedes pulchritarsis and Aedes geniculatus. They hibernate in the 4th stage. They rarely bite man during the day in shaded places.

5. Genus Culiseta Felt* (Theobaldia Neveu-Lemaire)

The name Theobaldia Neveu-Lemaire, 1902 is preoccupied by a genus of molluscs (1885).

134 Usually medium-sized or large mosquitoes. Spiracular setae present, postspiracular setae absent. Claws of female simple, pulvilli absent. Stem of radial vein with hairs in the basal part which are more numerous on the ventral surface. Scales on veins narrow. Cerci of female not projecting. Hypopygium: coxite usually with a lobe, style with a short appendage; claspettes absent.

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* A.V.Maslov (1964, 1967) was of great help in the preparation of this chapter.

Larvae large to very large, with a broad head (except in Allotheobaldia), mouth parts adapted to feeding on the substrate (Allotheobaldia) or to mixed Culiseta s. str.) or filtration feeding. Antennae short, with a weakly developed tuft (Allotheobaldia) or longer (Culiseta) or very long, with a tuft in the form of a broad fan (Culicella); variations of frontal hairs similar. Scales of comb on abdominal segment 8 numerous, without a main spine. Siphon of varying length, with a short pecten, often continuing toward the distal end as spines (Allotheobaldia, partly Culicella) or as a row of hairs (Culiseta s. str.). Tuft at base of siphon always present. Stigmal plate with a posterior process of the "stirrup" in the form of a more or less large plate. Main tracheal trunks either wide, ribbon-shaped, with oval cross section (Allotheobaldia, Culiseta s. str.) or narrow, with rounded cross section. Saddle either weakly developed (Allotheobaldia) or surrounding the last abdominal segment as a ring. Fin strongly developed, some of the tufts situated before the common base on the saddle. Gills of varying length.

The genus contains only about 30 species of which 12–13 occur only in the Palaearctic. Most of the species occur in the temperate zone of the Palaearctic and Nearctic.

Key to species

Females

1 (2). Mesonotum with distinct longitudinal white stripes forming a lyre-shaped pattern (Figure 70). Femora and tibiae with distinct white spots anteriorly. Costa covered with white scales in a large part. (Palps of males slightly shorter than proboscis.) (Subgenus Allotheobaldia Brol.) .... 1. C. (Allotheobaldia) longiareolata Macq.
2 (1). Mesonotum without white stripes. Femora and tibiae with uniformly dark scales or more or less numerous, scattered, light scales anteriorly. Costa covered mainly or completely with dark scales. (Palps of male longer than or as long as proboscis.)
3 (10). Cross-veins c–m and m–cu situated in a line; if they are slightly separated, the distance between them is usually not longer than the cross-vein m–cu. Wings often with dark spots. (Subgenus Culiseta Felt.)
4 (7). Tarsi dark.
5 (6). Wings with more or less indistinct dark spots .... 5. C. (Culiseta) bergrothi Edw.*
135 6 (5). Spots on wings absent or indistinct .... 2. C. (Culiseta) glaphyroptera Schin.*
7 (4). Tarsi with white rings.
8 (9). First segment of hind tarsi without a light ring in the middle; femora without subapical pale ring .... 3. C. (Culiseta) alakaensis Ludl.

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* The females of C. bergrothi and C. glaphyroptera are difficult to distinguish, but the hypopygium of males is distinctly different.

a (b). Dark scales on the body and legs and dark brown or black and white scales form the contrast of the pattern. Light scales on wings absent or few. Dark spots on wings distinct. A stripe of white scales at the base of the abdominal tergites which is narrower in the middle. Light scales absent in posterior half of tergites . . . . C. (Culiseta) alaskaensis alaskaensis Ludl.

b (a). Dark scales on body and legs and light brown or brown or light ocher-colored scales form a diffuse pattern on legs and body. Scattered light scales on the wings. Dark spots on wings indistinct. Stripes of pale scales on tergites indistinct; a few light scales are scattered all over the tergites . . . . C. (Culiseta) alaskaensis indica Edw.

9 (8). First segment of hind tarsi with a white ring in the middle; femora with a subapical, light ring . . . . . . 4. C. (Culiseta) annulata Schr.

a (b). Costa with dark (black) scales. Dark spots on wings distinct. Distinct anterior stripes of light (white) scales on the tergites; light scales absent in posterior half of tergites . . . . C. (Culiseta) annulata annulata Schr.

b (a). Costa with dark and light scales. Dark spots on wings diffuse. Light stripes indistinct at base of abdominal tergites and formed by yellowish (not white) scales; such scales are also present among the dark scales in the posterior half of the tergites . . . . C. (Culiseta) annulata subochrea Edw.

10 (3). Cross-vein m—cusituated distinctly nearer to the base of the wing than r—m, the distance between them usually at least the length of m—cu. Wings without dark spots. (Subgenus Culicella Felt.)

11 (14). Sternites of abdomen usually with a pattern of dark scales in the form of a V, its apex anteriorly.

12 (13). Light rings present on all segments of the fore, mid- and hind tarsi . . . . 9. C. (Culicella) fumipennis Steph.

13 (12). Light rings not present on all tarsal segments . . . . 9. C. (Culicella) setivalva Masl.

14 (11). Sternites of abdomen without a pattern of dark scales in the form of a V.

15 (16). Narrow stripes of light scales present only at base of tergites. Scales not forming spots on wings . . . . 6. C. (Culicella) morsitans Theob.

16 (15). Narrow, indistinct stripes of light scales at the base, sometimes also at the apex of the tergites, or else absent; tergites sometimes completely covered with light scales. There may be an indistinct dark spot in the middle of the wings, at the base of r_{4+5} . . . . 7. C. (Culicella) ochroptera Peus.

136 *Males*

1 (2). Tergite 9 with long lateral processes; aedeagus thick . . . . 1. C. (Allotheobaldia) longiareolata Macq.

2 (1). Tergite 9 simple, without lateral processes; aedeagus normal.

3 (4). Coxite with an apical lobe which has a tuft of long, scalelike plates . . . . 2. C. (Culiseta) glaphyroptera Schin.

4 (3). Apical lobe of coxite with hairs or lobe absent.

5 (6). Coxite with slightly convex apical lobe densely covered with short hairs . . . . 3. C. (Culiseta) alaskaensis Ludl.

6 (5). Coxite without apical lobe.

7 (8). Usually an area with dense hairs on the inner surface of the coxite before the apex. Phallosome strongly sclerotized . . . . 4. C. (Culiseta) annulata Schr.

8 (7). Area with dense hairs before apex of coxite absent. Phallosome usually weakly sclerotized.

9 (10). Coxite with long, strong setae, 2–3 setae on inner surface of coxite . . . . 9. C. (Culicella) setivalva Masl.

10 (9). Coxite with moderately long, thin setae.

11 (12). Basal lobe of coxite with 2 setae. Sternite 8 with a row of usually at least 10 spines in the middle of the posterior margin . . . . 5. C. (Culiseta) bergrothi Edw.

12 (11). Basal lobe of coxite with 3 large setae. Posterior margin of sternite 8 with fewer spines (at most 10) or without spines.

13 (14). Sternite 8 without spines at the posterior margin . . . . 7. C. (Culicella) ochroptera Peus (part).

14 (13). Posterior margin of sternite 8 with a comb consisting of densely placed spines or with a few scattered spines.

15 (16). Distal segments of palps of male (at least one segment) distinctly thickened . . . . 6. C. (Culicella) morsitans Theob.

16 (1) Distal segments of palps of male not thickened, as thick as the preceding segments.

17 (18). Basal lobe of coxite with 3–4 large setae . . . . 8. C. (Culicella) fumipennis Steph.

18 (17). Basal lobe of coxite with 5–8 large setae (rarely 3–4) . . . . 7. C. (Culicella) ochroptera Peus (part).

Larvae

1 (12). Siphon relatively short and thick (index at most 4). Main tracheal trunks broad, ribbonlike. Antennae shorter than the head, with a weakly developed tuft.

2 (3). Pecten of siphon with a few large denticles, widely separated, on the entire siphon. Spines on antennae absent; tuft short, situated in middle of antenna, with at most 3 branches (subgenus Allotheobaldia Brol.). . . 1. C. (Allotheobaldia) longiareolata Macq.

3 (2). Pecten of siphon with thinner denticles at the base, continuing
distally in a row of long hairs. Antennae with sparse spines;
137 tuft in middle of antenna short, slightly nearer the base, with more
than 5 branches (subgenus Culiseta Felt).

4 (7). Antennae about half as long as the head. Median frontal hairs with 4–8 branches. Comb usually with more than 60 scales.

5 (6). Antennae $^2/_3$ as long as the head. Pecten of siphon occupying about $^3/_4$ of length of siphon, with more hairs than scales. Before the

fin are 5 tufts, 3 of them situated on the saddle . . . . 2. C. (Culiseta) glaphyroptera Schin.

6 (5). Antennae half as long as the head. Pecten of siphon occupying $^2/_3$ of the length of the siphon, with as many scales as hairs or slightly more. Before the fin are 3–4 tufts, 2 of them situated on the saddle . . . . 5. C. (Culiseta) bergrothi Edw.

7 (4). Antennae less than half as long as the head. Median frontal hairs with 3 branches. Comb usually with less than 50 scales.

8 (9). Siphon shorter and thicker, slightly tapering apically, ratio of length to its width at the base 2.4–3.0 (2.7), and to its width at the apex 3.4–3.9(3.7). Scales of comb narrow, elongate, with parallel lateral margins, not distinctly wider at the base . . . . 3. C. (Culiseta) alaskaensis Ludl.

9 (8). Siphon longer and thinner, markedly tapering apically, ratio of length to its width at the base 3–4, to its width at the apex 5–6. Scales of comb slightly narrower in the middle, distinctly wider at the base.

10 (11). Distance between postclypeal hairs as large as distance between inner frontal hairs . . . . 4. C. (Culiseta) annulata Schr.

11 (10). Distance between postclypeal hairs shorter than distance between inner frontal hairs . . . . C. (Culiseta) annulata subochrea Edw.

12 (1). Siphon long and thin (index more than 5). Main tracheal trunks narrow, rounded. Antennae longer than the head, with a well developed tuft (subgenus Culicella Felt).

13 (16). In addition to the pecten, the siphon bears spines which are longer than the scales and irregularly scattered on the posterolateral surface. Hair at the base of the lateral valves of the stigmal plate forming a half-open fan on a chitinized base.

14 (15). About 50 scales in the comb. Median hair behind the comb as long as the last abdominal segment. Outer caudal hairs forming an asymmetrical fan, branched dorsally, with about 6 branches. Anterior tufts of the fin not situated on the common base, just more than half as long as the posterior tufts . . . . 8. C. (Culicella) fumipennis Steph.

15 (14). About 100 or more scales in the comb. Median hair behind the comb much shorter than last abdominal segment. Outer caudal hairs with 3 branches. Anterior tufts of fin not situated on the common base, as long as or only slightly shorter than the posterior tufts . . . . 9. C. (Culicella) setivalva Masl.

16 (13). Additional spines apart from the pecten on the siphon absent. Hair at base of lateral valves of stigmal plate of the usual structure.

138 17 (18). Inner frontal hairs with 5–9 branches. Scales at posterior margin of comb with a dark, longitudinal ridge, pointed at the end. Hair at posterior valves of stigmal plate curved only at the end. Gills 1.5–2 times as long as the saddle . . . . 7. C. (Culicella) ochroptera Peus.

18 (17). Inner frontal hairs with 2–3 branches. Scales at posterior margin of comb without dark longitudinal ridge. Hair at posterior valves of stigmal plate curved their entire length. Gills shorter than the saddle . . . . 6. C. (Culicella) morsitans Theob.

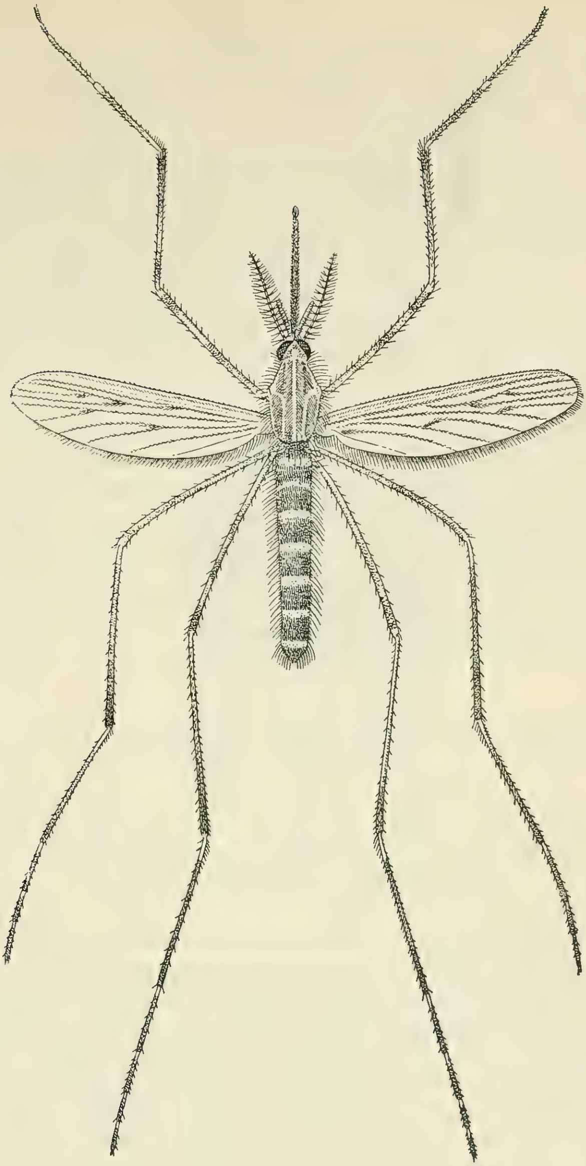

FIGURE 70. Culiseta longiareolata Macq.

1. Subgenus Allotheobaldia Brolemann

The males of this subgenus have short palps which are about $^3/_4$ as long as the proboscis. Coxite without apical lobe, tergite 9 with 2 long processes, aedeagus thick.

Larvae with a small head, which is less than 1.5 times wider than long; mouth parts of the mixed type of feeding, substrate feeding type predominating over filtration type. Antennae short, without spines, with a short, slightly branched hair. The short siphon is usually not sclerotized to the base and has no auricles. There is a pair of hair tufts at the base and a pecten consisting of a few spine-shaped, widely separated denticles on the entire length of the siphon. Main tracheal trunks broad, ribbon-shaped. Last abdominal segment with a weakly developed saddle, markedly branched tufts of the fin and short gills.

The only species of the subgenus is C. (All.) longiareolata.

It was recently suggested (Maslov, 1964) that the subgenus Allotheobaldia Brol. be removed from the genus Culiseta and considered as a distinct genus. C. (All.) longiareolata Macq. indeed differs from all other species of the genus in the structure of the hypopygium, the length of the palps of the male and other characters, but the same standard should be maintained in different groups of the family. In some genera (e.g. in Aedes, Culex) the differences between the species are at least as substantial as in Culiseta. The differences of C. (All.) longiareolata are sufficiently recognized if the species is placed in a different subgenus.

1. Culiseta (Allotheobaldia) longiareolata Macquart, 1838

This species differs sharply from all other Palaearctic species of the genus in the white, lyre-shaped pattern on the mesonotum (Figure 70) and in the white scales on the anterior margin of the costa.

Head with broad, white, contiguous scales dorsally in the middle, with sparse brown setae laterally. There are also white scales at the sides of the head and on the occiput and dense white scales along the margin of the eyes. Palps of male brown, shorter than the proboscis, long segment of palps white at the base and in the middle; penultimate segment of palps with white scales at the base, last segment with white scales also at the apex; last segment markedly thickened and short. Palps of female short,
140 with dark brown and white scales; apex of palps of female with white scales. Proboscis blackish brown. Antennae of male blackish brown, with white rings at the base of the segments and long brown hairs; antennae of female blackish brown, the basal segments with white scales. Mesonotum with brown or yellowish brown, narrow scales; a median stripe of white scales from the anterior margin to the scutellum; similar white stripes in the anterior half of the mesonotum at the lateral margin; they turn inward along the transverse suture and extend to the scutellum lateral to the dorsocentral setae; mesonotum with white scales at the base of the wings, on the scutellum and on the pleurae. Legs black, with numerous white spots which often form longitudinal stripes; femora and tibiae covered with white scales on a large part of the posterior surface; tarsi black, with scattered spots

of white scales and narrow, white rings at the base of the first 2, 3 or 4 segments (on the hind tarsi); claws of female simple, claws of male with a denticle on the fore and mid-tarsi. Wings with brown scales on the veins; costa with white scales on the entire anterior margin. Abdomen markedly varying in color of scales, usually with brown scales dorsally, with broad transverse stripes of white scales at the base of the tergites; posterior third of tergites with yellowish scales which often form a process to the white scales at the anterior margin or cover the part of the tergite without white scales (often on the posterior tergites), replacing the brown scales; sternites with white scales. Sternite 8 of female with 2 broad lobes with an incision between them.

Hypopygium (Figure 71) with strongly developed, finger-shaped process of tergite 9 and a thick, sclerotized aedeagus.

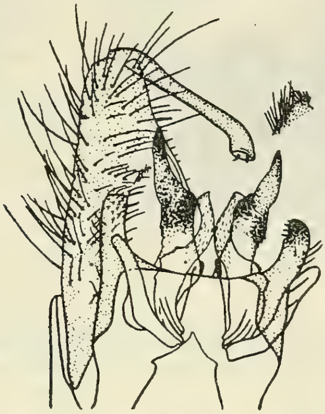

FIGURE 71. Hypopygium of Culiseta longiareolata Macq.

Fourth-stage larva (Figure 72) large, gray, with small dark head and short siphon. Head less than 1.5 times wider than long. Frontal hairs weakly developed: outer hairs with 3–4 branches, median hairs situated before the inner, simple; inner hairs simple, rarely 2-branched. Postclypeal hairs simple, situated between the median frontal hairs. Antennae short, without spines, with a short hair with 1–3 branches which is not longer than twice as long as the width of the antenna.

Comb with 40–75 scales, very variable in size and form, with a distinct spine or only with a row of denticles. The median hair behind the comb is strongly developed.

Siphon (index 1.5–2.1) dark, but usually not sclerotized to the base; auricles absent. Pecten with 4–7 large, smooth spines, widely separated
141 on the entire siphon, and with 3–7 smaller, rudimentary denticles in its basal, not sclerotized part. There are all transitions between these denticles and the scales of the comb. A hair tuft with 10–15 secondarily feathered branches, thinner and shorter than on the median hair behind the comb, at the base of the siphon near the border of the sclerotized part.

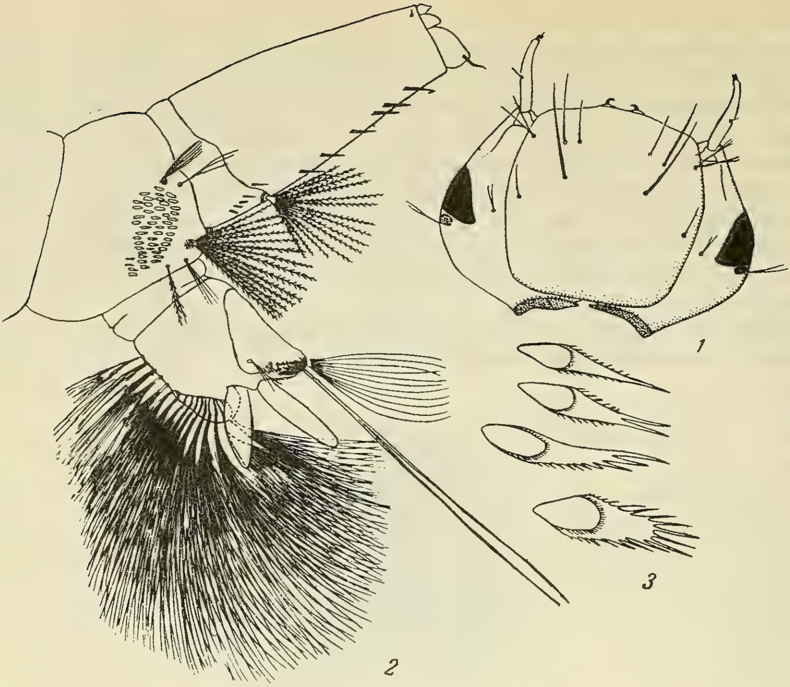

FIGURE 72. Culiseta longiareolata Macq. Fourth-stage larva:

1 — head, dorsal; 2 — posterior end, lateral; 3 — scales of comb.

Last segment of abdomen with a weakly developed saddle which covers at most $^3/_4$ of its dorsal side and extends little to the sides; its posterior margin with dense, short spines. Outer caudal hairs as long as the siphon, with 1–2 branches, inner caudal hairs forming a fan with 10–16 branches, as long as the fin, which consists of 16–18 strongly branched tufts. Length of gills very variable, according to the salinity of the water, 0.5–1.5 times as long as the last segment.

Distribution. Mainly Mediterranean. USSR: steppe and desert zones, Central and Southern Ukraine to Kharkov, Lower Volga area, Northern Caucasus, Transcaucasia (Georgia, Armenia, Azerbaidzhan), Kazakhstan and some southern regions of West Siberia (Omsk), Middle Asia (Turkmenia, Uzbekistan, Tadzhikistan, Kirghizia). Western Europe to southern England; Africa; Southwest Asia, to Iran, India and Pakistan.

Biology. The larvae inhabit shallow pools, wells, prospecting pits, 142 etc. and natural waters, fresh or slightly saline. They tolerate a high degree of pollution. Most of their life is spent at the surface; they rarely descend to the bottom. They often occur together with larvae of Culex pipiens, rarely with larvae of Aedes caspius. The larvae hibernate. In Middle Asia they continue to develop even in cold water so that adults are found even in winter. They rarely bite man but transmit blood parasites of birds. Several plasmodia of birds may complete the cycle of sporogony in this species. Autogenous deposition of eggs has been found in some populations.

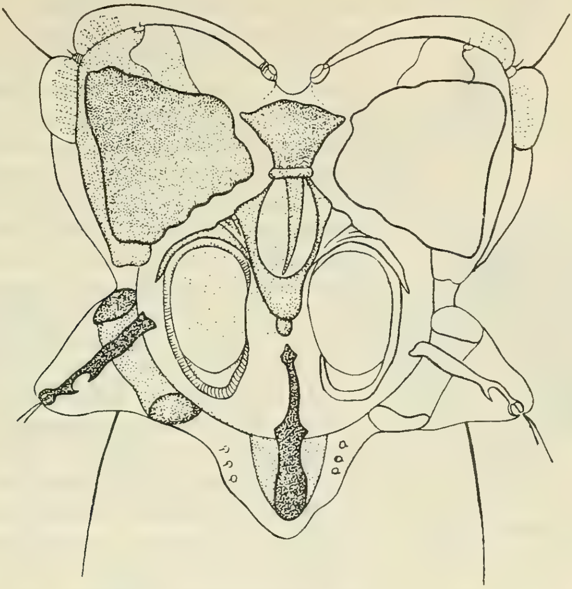

FIGURE 73. Culiseta longiareolata Macq. Fourth-stage larva. Stigmal plate.

2. Subgenus Culiseta Felt

Palps of male longer than or as long as the proboscis, with 2 thickened, apical segments. Coxite often with a subapical lobe or a sharply defined area of dense hairs in the upper third of the inner surface; tergite 9 without long appendages; aedeagus normal: phallosome markedly sclerotized, with curved apical parts in most species.

Head of larva usually 1.5 times wider than long; mouth parts usually of the mixed type of feeding, with short antennae which are only rarely (C. glaphyroptera) more than half as long as the head, with a relatively short tuft and with subapical and apical setae in two groups. Comb with numerous densely arranged scales. Siphon moderately long (index less than 4), with a pair of hair tufts at the base and pecten continuing distally in a row of long, thin, dense hairs. Main tracheal trunks broad, ribbon-shaped. Saddle surrounding the last segment completely like a ring. Two to four tufts of the fin situated on the saddle. Outer caudal hairs with a few branches.

The subgenus is represented in the Palaearctic by six species, one of them Oriental.

2. Culiseta (Culiseta) glaphyroptera Schiner, 1864

The species is characterized by the structure of the hypopygium and by the dark brown tarsi without light rings and the absence or weak development of dark spots on the wings.

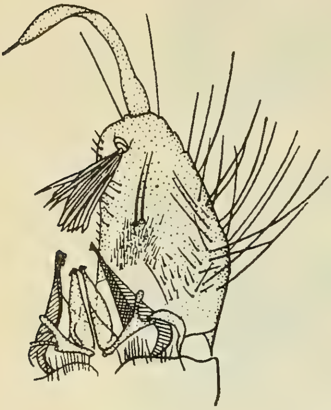

FIGURE 74. Hypopygium of Culiseta glaphyroptera Schin.

Head laterally and dorsally with whitish scales at margin of eyes, dorsal part of occiput with upright, brown scales. 143 Proboscis and palps dark brown in both sexes, palps of male distinctly longer than the proboscis, with widened but flattened terminal segment. Antennae of male brown, with light rings on the basal and middle segments and uniformly brown terminal segments; antennae of female brown. Mesonotum with brown or golden brown scales which form indistinct stripes and spots; pleurae of thorax with contiguous white scales in some places. Legs with brown scales; posterior surface of femora and tibiae with yellowish white scales; tarsi dark brown, without light rings. Wings with dark brown scales, sometimes with indistinct spots of darker scales at the base of the radial and medial forks and at the crossveins. Abdomen dark brown dorsally, with transverse stripes of white scales at the anterior margin of the tergites which occupy about $\frac{1}{3}$ of the length of the tergite; sternites with white scales in a large part and stripes of brown scales at the posterior margin.

Hypopygium (Figure 74): tergite 9 without lateral processes; coxite with a subapical process with a group of long, scalelike plates.

144 Fourth-stage larva (Figure 75) large, yellowish brown, semitransparent, with a broad head. Frontal hairs strongly developed, secondarily feathered, outer hairs with 8–12, median hairs with 5–7, inner hairs with 7–9 branches, reaching to the labrum. Postclypeal hairs situated before the inner frontal hairs, close together. Antennae long, distinctly more than half as long as the head, with a hair tuft in the middle slightly nearer to the base, about half as long as the antenna, usually with 10 branches. Mouth parts of the filtration type, without comblike ends on the inner hairs of the labrum, but with short outer lobes.

Comb with 60–70 or more elongate scales with wide base, narrower in the middle and with broad, rounded end; margin of scales with a row of variously developed spines. Siphon (index 3.4–3.5) weakly tapering in apical third. Pecten with 12–14(usually 15–21) spinelike denticles, continuing apically in a row of 17–29 (usually 19–22) longer hairs to the apical quarter of the siphon. Siphonal hair tuft situated near the base, between denticles 9–12 of the pecten, with 8 branches that are distinctly longer than the width of the siphon at the base. Stigmal plate resembling that of C. alaskaensis but distinctly smaller.

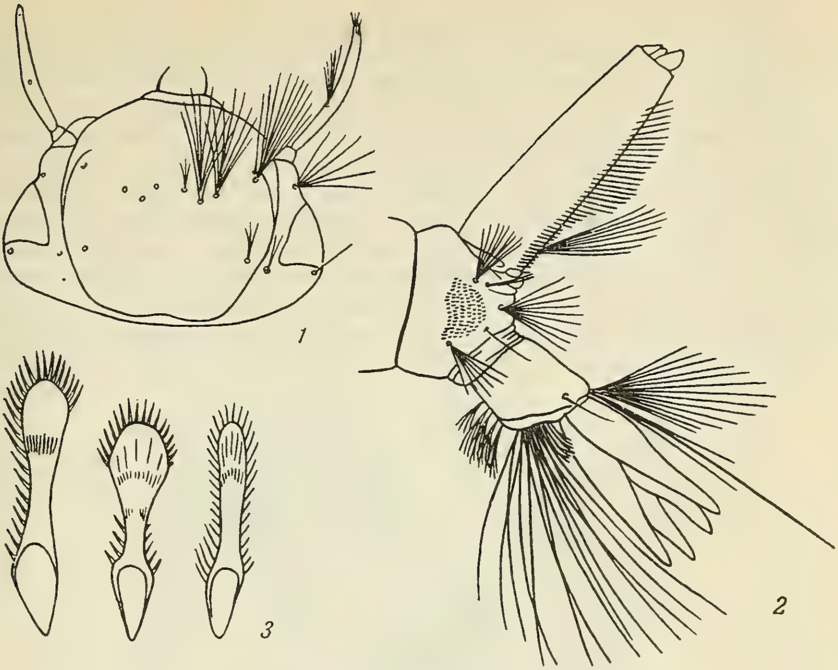

FIGURE 75. Culiseta glaphyroptera Schin. Fourth-stage larva (after Peus):
1 — head, dorsal; 2 — posterior end, lateral; 3 — scales of comb.

Last abdominal segment completely surrounded by the saddle, which has a deep incision on the ventral side. Outer caudal hairs with 3–4 branches, inner caudal hairs forming a fan, usually with 14 branches. Lateral hair short, 2-branched. Fin with 13–16 tufts on the common base and 5 shorter tufts before it. The anterior 3 tufts are situated on the saddle. Gills 1.5–2.5 times as long as saddle, transparent, pointed at the end.

Distribution. Mountains of Central and Southeastern Europe. USSR: Transcarpathians; records from other regions of the USSR (Leningrad Region and others) apparently refer to C. bergrothi.

Biology. The species is restricted to mountain regions. The larvae occur in partly shaded water with a stony bottom in small mountain rivers and streams. They are not found in pure, transparent water with a clean, stony bottom with poor microflora and fauna; often common in polluted water with fallen leaves and rich detritus.

3. Culiseta (Culiseta) alaskaensis Ludlow, 1906

The species differs from other Palaearctic species of the subgenus with dark spots on the wings in the absence of white rings before the apex of the femora and in the middle of the first segment of the hind tarsi.

Head dorsally and laterally with yellowish white, contiguous scales and
with dark brown, upright scales. Antennae of male as in C. glaphyrop-
tera; antennae of female dark brown, 2–3 basal segments, especially on
the inner side, with white scales. Proboscis and palps of both sexes with
brown scales mixed with white scales; palps of male distinctly longer than
the proboscis. Mesonotum with dark brown and golden scales which form
spots or are irregularly distributed; lateral parts of mesonotum usually
145 lighter; pleurae of thorax with spots of white scales. Legs: femora and
tibiae anteriorly with black scales mixed with numerous white scales;
posterior surface and apex also with white scales; tarsi black, with white
rings at the base of segments 2–3 or segments 2–4 (hind tarsi). Wings
with dark brown scales mixed with isolated white scales; black scales
forming dark spots at the cross-veins and forks $r_2 + r_3$, $m_1 + m_2$ and $m_{3+4} + cu_1$.

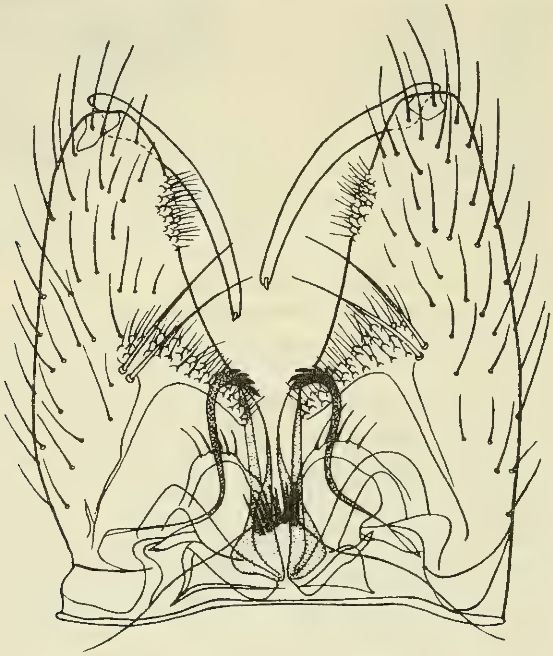

FIGURE 76. Hypopygium of Culiseta alaskaensis Ludl.

Abdomen with black scales dorsally, with stripes of white scales at the base of the tergites which are about $^1/_3$ as long as the tergite and slightly narrower in the middle; ventral side nearly completely with white scales.

Hypopygium (Figure 76): sternite 8 with a comb of short spines at the posterior margin near the middle; coxite with a slightly convex subapical lobe with dense hairs; basal lobe of coxite with 2, rarely 3, strong setae, which are sometimes bent at an angle. Phallosome sclerotized.

Fourth-stage larva (Figure 77) very large, yellowish brown to nearly black. The abdomen of young larvae often appears transversely striated by pigment in the outer layer of the fat body, which is absent between the segments.

(146)

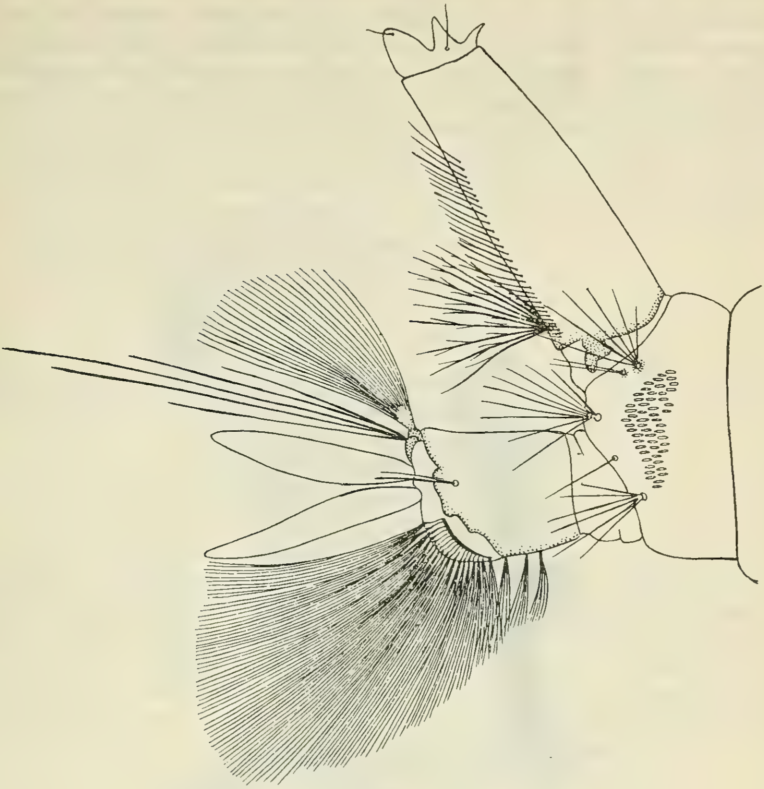

FIGURE 77. Culiseta alaskaensis Ludl. Fourth-stage larva. Posterior end, lateral.

Head broad. Frontal hairs secondarily feathered, outer hairs shorter, with 9–11 branches, median hairs with 2–3, inner hairs with 5–6 branches. Postclypeal hairs short, thin, 3-branched, the distance between them as long as the distance between the inner frontal hairs. Antennae distinctly less than half as long as the head; hair tuft situated at $^2/_5$ of the antenna from the base, with 8–11 branches which reach to the apex. Mouth parts of the mixed type.

Comb with 35–55(46) scales of varying form but not narrower in the middle and with longer, dense spines at the rounded end. Siphon short, broad, slightly tapering apically, index 2.5–3.0, ratio of length to width at the apex 3.4–3.9. Pecten with 6–8 long, spinelike denticles and 3–6 rudimentary denticles at the base, continuing apically in a row of 16–18 hairs which are usually of the same length except for the 2–3 shorter distal hairs.
146 Hairs not reaching apical third or quarter of siphon. A hair tuft with 7–10

weakly secondarily feathered branches at the base which are slightly more than half as long as the siphon. Stigmal plate very large (Figure 78). Last segment about half as long as the siphon, saddle surrounding it completely. Outer caudal hairs with 3–5 branches, middle branch as long as the siphon, inner hairs forming a large fan with 22–27 branches. Lateral hairs short, with 2–3 branches. Fin with 16–18 strongly developed tufts and 3–4 shorter tufts before the common base. Gills 1.5 times as long as the saddle or shorter, lanceolate, pointed at the end.

(147)

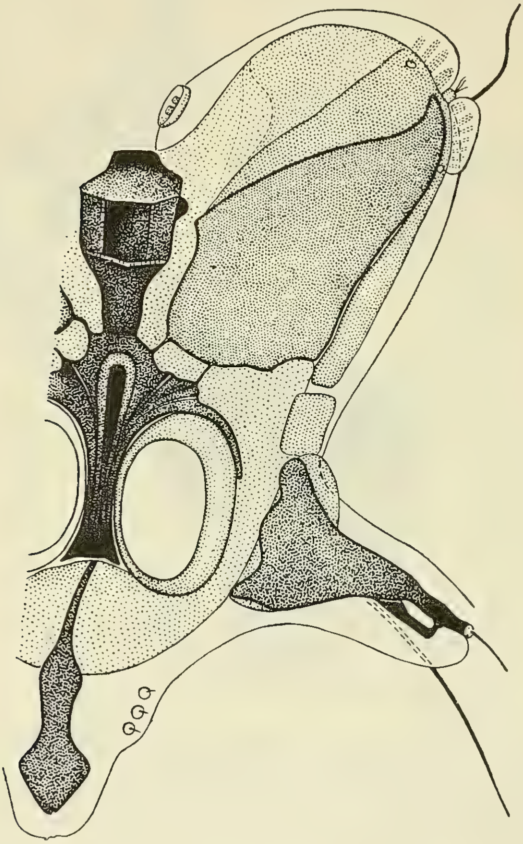

FIGURE 78. Culiseta alaskaensis Luld. Fourth-stage larva. Stigmal plate.

Distribution. Boreal zone of the Palaearctic and Nearctic. The species occurs in the tundra, taiga and forest zone of the USSR. It also occurs in the northern regions of the European and Asian parts of the USSR (Kola Peninsula, Cape Chelyuskin). Western Europe. North America. South of the USSR, in mountain regions in Iran and Pakistan; the subspecies C. (C.) alaskaensis indica occurs in Northern India.

Biology. The larvae are usually found in partly shaded water which does not dry up in summer and which has little aquatic vegetation and with fallen leaves at the bottom, also in clearings of broadleaved forests or shrubs or in open areas near them; they inhabit swamps in the tundra.
147 Often found together with larvae of Aedes cinereus, A. caspius dorsalis, A. cantans, A. excrucians and others, rarely with larvae of Anopheles maculipennis or Culex territans. They hibernate as adults in tree holes, caves, cellars, often together with Culex pipiens, Anopheles maculipennis, Helomyzidae (Acalyptrata), Petauristidae (Nematocera) and Mycetophilidae. They usually leave their winter places earlier than other species of mosquitoes (in mid- or late April near Leningrad). They bite man rarely, usually at dusk and in bright sunlight. They attack reindeer in the tundra and forest-tundra.

Culiseta alaskaensis alaskaensis Ludlow

It occurs to the southern border of the forest zone. Specimens from southern regions are lighter.

Culiseta alaskaensis indica Edwards, 1920

Much lighter than the nominate subspecies. Palps of male often with light scales. Mesonotum with golden yellow scales. Abdomen often with broader stripes of white scales at the base of the tergites. Hypopygium mainly as in the nominate subspecies, but the spines at the posterior margin of sternite 8 are often weakly developed (only 3 spines in some specimens).

The larvae do not differ from those of the nominate.subspecies.

Distribution. Mountain regions of the southern USSR: Caucasus, Middle Asia, Uzbekistan, Tadzhikistan, Kirghizia, Kazakhstan.

4. Culiseta (Culiseta) annulata Schrank, 1776

The species is closely related to C. alaskaensis, but differs from it in the presence of a white ring in the apical third of the femora and in the middle of the first segment of the hind tarsi.

Head with yellowish white, contiguous scales at the sides which are especially dense along the posterior margin of the eyes; head with yellowish brown setae dorsally, with upright scales of the same color posteriorly. Proboscis of male light brown, with yellowish white scales in a large part;
148 palps of male distinctly longer than the proboscis, light brown, with broad, light rings at the apex of the penultimate and base of the last segment; hairs on palps brown, with yellowish white scales in some places; proboscis of female brown, with brown and white scales; palps short, brown, apical segments with white scales, otherwise brown scales. Antennae as in C. alaskaensis. Mesonotum with brown, golden and white scales which are broader in the lateral parts; pleurae of thorax with spots of broad, white scales; scutellum with white scales. Legs blackish brown, with dark

brown scales, with spots of white scales on femora and tibiae; posterior side of femora and tibiae with white scales in a large part; femora with a distinct white ring in the apical third, knees and articulation of tibia and tarsus with white scales, tarsi with white rings in middle of first segment and at base of 2nd, 3rd and 4th segment. Wings with brown scales, with scattered white scales in the anterior part; cross-veins and forks r_2+r_3, m_1+m_2 and $m_{3+4}+cu_1$ with distinct spots of blackish brown scales. Abdomen dark brown, with white anterior transverse stripes about $^1/_3$ of the length of the tergite; tergites with dark brown scales posteriorly; tergite 2 usually with a narrow longitudinal stripe of white scales in the middle; sternites with yellowish white scales.

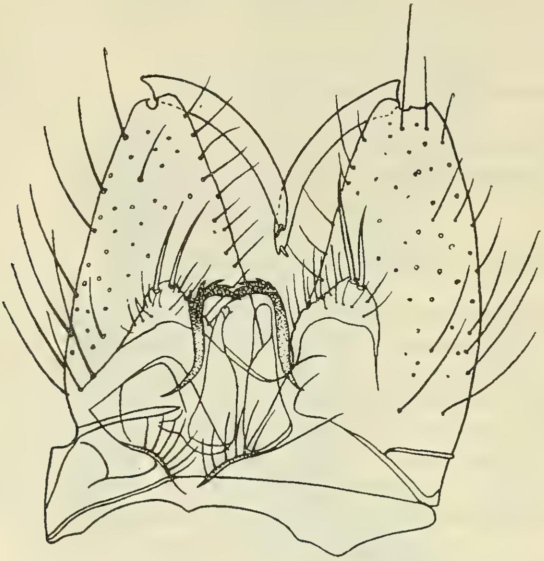

FIGURE 79. Hypopygium of *Culiseta annulata* Schr.

Hypopygium (Figure 79): basal lobe of coxite with 2–5 curved, strong setae; there is usually a subapical area densely covered with scales on the inner surface of the coxite. Phallosome strongly sclerotized. Spines at posterior margin of sternite 8 usually absent.

Fourth-stage larvae (Figure 80) large, yellowish brown or greenish brown. Head broad. Frontal hairs as in *C. alaskaensis*. Postclypeal hairs and inner frontal hairs equally widely separated. Antennae distinctly less than half as long as the head, with a hair tuft with 10–15 branches in the middle, not reaching the apex. Mouth parts of the mixed type, with indistinct combs at the ends of the inner hairs of the labrum. Comb with 40–50 or more scales which are slightly narrower in the middle. Siphon relatively longer and more strongly tapering apically than in
149 *C. alaskaensis*; index 3.6–4.0, ratio of length:width at the apex 6. Pecten with 11–18(13–15) spinelike denticles, the basal denticles often

rudimentary. The denticles pass distally into a row of 11–21(14–17) hairs which reach to half, rarely 2/3, of the length of the siphon. Hair tuft situated slightly away from the base, usually with 9–10 weakly secondarily feathered branches, not half as long as the siphon. Stigmal plate as in C. alaskaensis, but distinctly smaller. Last abdominal segment less than half as long as the siphon, the saddle surrounding it completely like a ring. Outer caudal hairs with 3 branches, median hairs half as long as the siphon, inner hairs with 13–19 branches, lateral hair thin, with 3 branches. Fin usually with 18 tufts, the anterior tufts short, passing without distinct border into the tufts before the common base. Gills lanceolate, as long as the saddle.

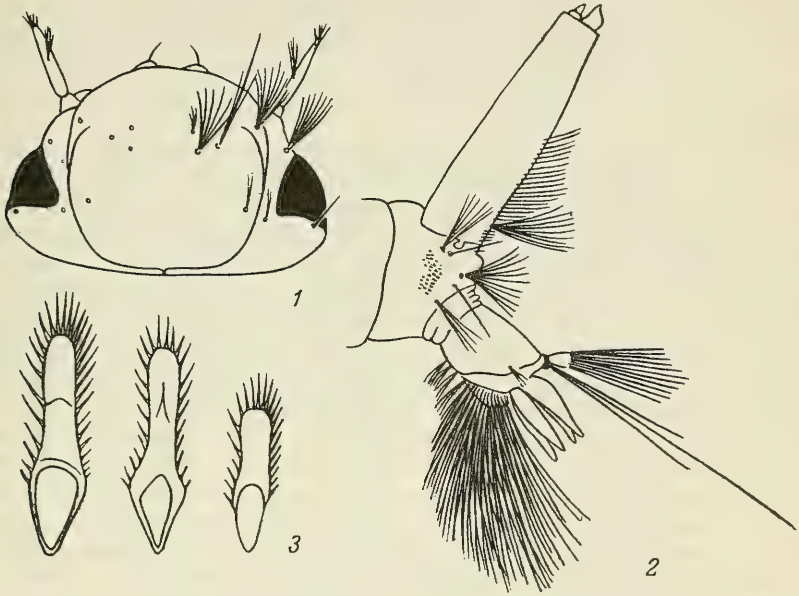

FIGURE 80. Culiseta annulata Schr. Fourth-stage larva (after Peus):

1 — head, dorsal; 2 — posterior end, lateral; 3 — scales of comb.

Distribution. European USSR, to the Leningrad Region and Estonia in the north; Caucasus and Transcaucasia (mountains); Middle Asia, Kazakhstan. Widely distributed in Western and Central Europe, Sweden and Norway; Mediterranean; North Africa; Southwest Asia.

Biology. The habitats of the larvae are very varied, artificial and natural water bodies, puddles, ditches, reservoirs, barrels, and marshes. They tolerate moderate pollution. Sometimes found in water with duckweed. Hibernation normally in the adult stage; larvae may hibernate in southern latitudes (southern coast of the Crimea). The mosquitoes feed mainly on mammals but also bite man and birds to whom they transmit some plasmodia of birds. In the southern part of the European USSR and in the Caucasus the species is very common; it is rare in the north (Leningrad Region, Estonia).

With the characters of the species: Hypopygium: basal lobe of coxite usually with 2 large setae; spines at posterior margin of sternite 8 often absent, if present, at most 4 spines.

Culiseta annulata subochrea Edwards, 1921

It differs from the nominate subspecies in the more weakly developed spots on the wings and the more numerous white scales, especially in the anterior part of the wings. Except for the narrow white stripes at the base of the tergites, the abdomen is nearly entirely covered with ocher-yellow scales, usually with some isolated brown scales; white rings on tarsi much wider than in the nominate subspecies. Hypopygium: basal lobe of coxite usually with 3–4 strong setae; spines often present (4–8) at posterior margin of sternite 8.

Fourth-stage larva large, light to dark brown, with lighter head and siphon. Head broad. Frontal hairs secondarily feathered, outer hairs with 7–12 branches, median hairs with 3 (rarely 2), inner hairs with 5–8 branches; postclypeal hairs with 3–4 thin branches, the distance between them less than the distance between the inner frontal hairs. Antenna about half as long as the head; hair tuft situated in the middle, slightly basal to the middle, with 9–14 thin branches nearly reaching to the end of the antenna. Mouth parts of the mixed type of feeding. Comb with 30–50 scales resembling those of C. annulata but with more densely arranged scales and with narrower base. Siphon as in C. annulata (index 3.3–3.6; ratio of length to width at the apex 4.5–5.3). Pecten with 10–15 thin, spine-like denticles and 2–5 small, rudimentary spines at the base. Pecten passing into a row of hairs (18–26), the basal hairs 0.3–0.4 as long as the siphon. Hair tuft with 7–11 secondarily feathered hairs situated slightly away from the base, usually less than half as long as the siphon. Stigmal plate as in C. annulata. Last segment less than half as long as the siphon, saddle surrounding it completely. Outer caudal hairs with 3–5 branches; the ventral hairs are the longest, longer than the siphon, the inner hairs forming a fan with 16–19 branches. Lateral hair thin, 3-branched. Fin with 16–18 tufts, 2–3 tufts before the common base. Development of tufts as in C. annulata. Gills lanceolate, with pointed end, slightly shorter than the saddle.

Distribution. Widely distributed in Middle Asia. Occurs in southern Norway, Finland, Denmark, England, France and other countries. North Africa, Southwest Asia (Palestine, Syria, Iran, Iraq). The areas of distribution of the two subspecies overlap in Western and Central Europe.

Biology. The subspecies is typically halophilous. The larvae are found in pools with rich aquatic vegetation. In southern latitudes (Middle Asia), they occur mainly in water well shaded by trees or reeds, or in deep wells. The females hibernate. The larvae may apparently also hibernate, so that adults appear early. There are 4–5 generations per year. Rarely bites man.

151 5. Culiseta (Culiseta) bergrothi Edwards, 1921
(borealis Shingarev, 1927)

The species is characterized by uniformly black tarsi without white rings and indistinct dark spots on the wings; r–m situated slightly more distally than m–cu.

Head with pale golden contiguous scales and blackish brown upright scales and setae. Proboscis with black scales with a metallic sheen. Palps of female with black scales and a few light scales. Palps of male long, with blackish brown scales and with long, yellowish brown hairs in the apical half (from apical part of long segment). Mesonotum markedly varying in color, either more or less uniformly but not densely covered with narrow, golden scales or with dark brown, nearly black scales with longitudinal stripes of golden scales in the posterior half of the mesonotum along the dorsocentral setae of the same color and with broader stripes along the lateral margins of the mesonotum; lateral margins of the bare space before the scutellum and scutellum covered with narrow, white scales; posterior margin of scutellum with long, blackish brown setae; pleurae of thorax with spots of white, lanceolate scales. Legs: femora and tibiae with blackish brown scales anteriorly and scattered white scales, particularly in basal part of femora; femora and tibiae posteriorly and hind femora also anteriorly, except on the dorsal surface and an indistinct subapical ring, and also the apex of all femora and tibiae, with white scales. Tarsi black, without light rings; first segment of fore tarsi of male very long, usually longer than the other tarsal segments together. Wings with narrow, dark brown scales on the veins and indistinct dark spots at the base of the radial and medial forks, and on the cross-veins.

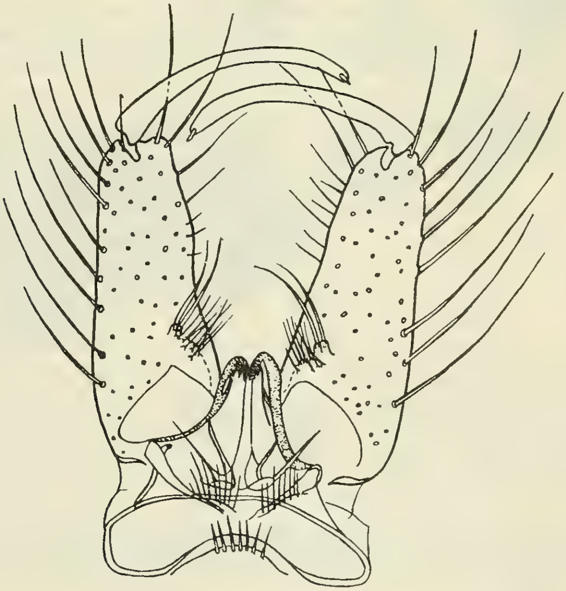

FIGURE 81. Hypopygium of Culiseta bergrothi Edw.

Abdomen with black scales, with moderately broad stripes of white scales at the base of the tergites; dark scales on dorsal surface sometimes with a bluish or metallic sheen.

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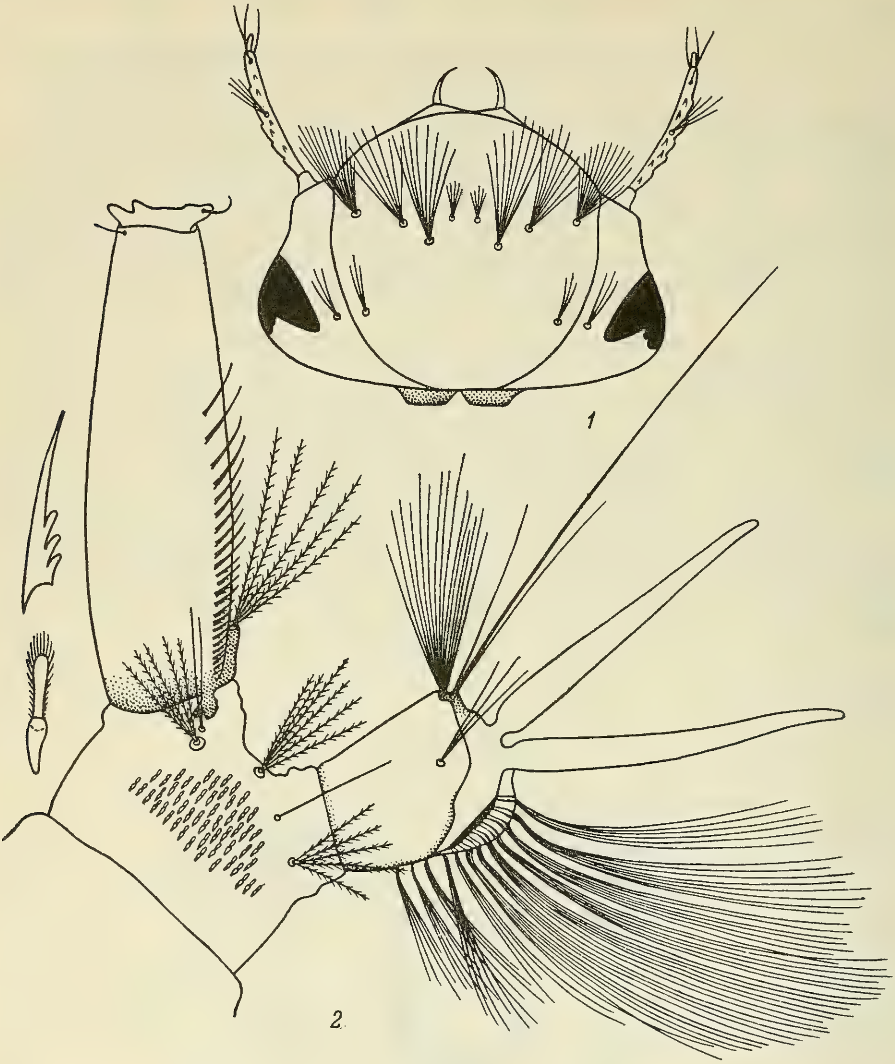

FIGURE 82. Culiseta bergrothi Edw. Fourth-stage larva:

1 — head, dorsal; 2 — posterior end, lateral.

Hypopygium (Figure 81): coxite long; basal lobe well developed, with 2 strong, long setae; apical lobe absent; sternite 8 with a row of spines at the posterior margin.

Fourth-stage larva (Figure 82) large, grayish brown or yellowish
152 brown. Head broad. Frontal hairs secondarily feathered, outer hairs with 8–16(10–11) branches, median hairs with 5–9(6–7), inner hairs with 9–13 (10–11) branches; postclypeal hairs with 2–6(3–5) branches situated close together before the inner frontal hairs. Antennae half as long as the head; hair tuft with 5–14(9–11) secondarily feathered branches which reach to the apex of the antenna, situated slightly basal to the middle. Mouth parts of the filtration type.

Comb with 50–80(60–70) narrow, long scales, narrower basally; margins with a row of spines, situated closer together at the distal end. Siphon distinctly tapering apically, of varying length. In larvae from the Far East the index is 3.1–4.1(3.6–3.9) and in larvae from Karelia 2.8–3.6(3.2). The pecten consists of 14(9–22) moderately long denticles with 2–3 accessory denticles at the base and 2–8(3–4) rudimentary denticles at the basal ring
153 of the siphon; it continues in a row of 7–15(10–12) hairs, the 3–4 basal hairs shorter; the hairs extend to $^2/_3$ of the siphon from the base. Tuft with 4–9(6–7) secondarily feathered branches, as long as the last segment, situated near the base. Stigmal plate as in C. annulata, more strongly pigmented, much smaller than in C. alaskaensis. Saddle incised on the ventral side, surrounding the segment completely. Outer caudal hairs with 2–4 branches, median hairs longer than the siphon, inner hairs forming a fan with 13–16 branches, lateral hair with 2–6 short branches. Fin with 13–19 strongly developed tufts and 3–4 shorter and less branched tufts before the common base; 1–2 tufts situated in the ventral incision and 2 tufts on the saddle. Gills narrow, lanceolate, with pointed ends, usually twice as long as the saddle.

Distribution. Widely distributed in the southern part of the tundra in the USSR (Kola Peninsula, Nenets National District), in the taiga and the northern part of the forest zone. In the Far East it spreads to the broad-leaved forest zone. Northern Europe (Sweden, Norway, Finland).

Biology. The larvae occur in stagnant water, swamps in the tundra, pools in forests and ponds in inhabited areas. In the southern part of its distribution, the species inhabits shaded water bodies and tolerates a high degree of pollution. There is one generation per year in the north, 2–3 in the south. Females hibernate. They feed on mammals, mainly cattle, and sometimes enter homes and cattle sheds.

3. Subgenus Culicella Felt

Palps of male as long as or longer than the proboscis; last two segments of palps not thickened or more or less thickened, with distinct hairs; femora and tibiae without sharply defined light spots; wings without dark spots; cross-vein m–cu situated distinctly before r–m; coxite without subapical lobe or with a sharply defined area of dense hairs. Tergite 9 without processes; phallosome weakly sclerotized, its terminal part slightly curved, but not hook-shaped.

Larvae large, with broad head and mouth parts of the filtration type, with long, curved antennae, the strongly developed tuft on the antennae situated far distal to the middle; two long setae situated near the apex, which bears only one long seta. Siphon (index 5–7) with a pair of tufts at the base and a pecten with a few spinelike denticles. Last abdominal segment long, with a ring-shaped saddle surrounding it completely. Outer caudal hairs branched. Gills moderately long, with pointed ends. Main tracheal trunks thin, rounded.

The subgenus contains 8 species of which 5–6 are Palaearctic.

6. Culiseta (Culicella) morsitans Theobald, 1901

Head with yellowish white scales and with upright, brown scales dorsally which gradually pass into long, brown setae anteriorly. Proboscis of male 154 light brown, slightly darker at base and apex, with pale yellowish scales; palps of male distinctly longer than the proboscis, brown, with broad, light rings at the base and narrow light rings on the two terminal segments; terminal segment distinctly thickened; proboscis and palps of female dark brown, with blackish brown scales. Mesonotum with narrow, brown and golden scales (golden scales in the midline, near the dorsocentral setae and at the lateral margin); pleurae of thorax with spots of white scales; scutellum with golden scales. Legs brown; femora and tibiae with brown scales anteriorly, with yellowish white scales posteriorly; knees and articulation of tibia and tarsus with white spots; tarsi with narrow, white rings at the base of the 2nd, 3rd and sometimes 4th segment. Wings with brown scales, without spots. Abdomen with brownish black integument and scales, with narrow stripes of white scales at the base of the tergites and with yellowish white scales ventrally.

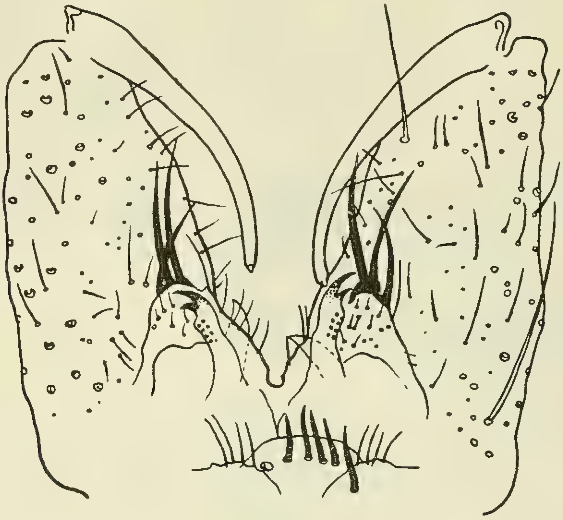

FIGURE 83. Hypopygium of Culiseta morsitans Theob. (after Natvig).

Hypopygium (Figure 83): coxite at most 3 times as long as wide at the base; basal lobe of coxite with 3–6 strong setae; sternite 8 with an irregular row of spines or with 3–10 long, strong setae at the posterior margin.

(155)

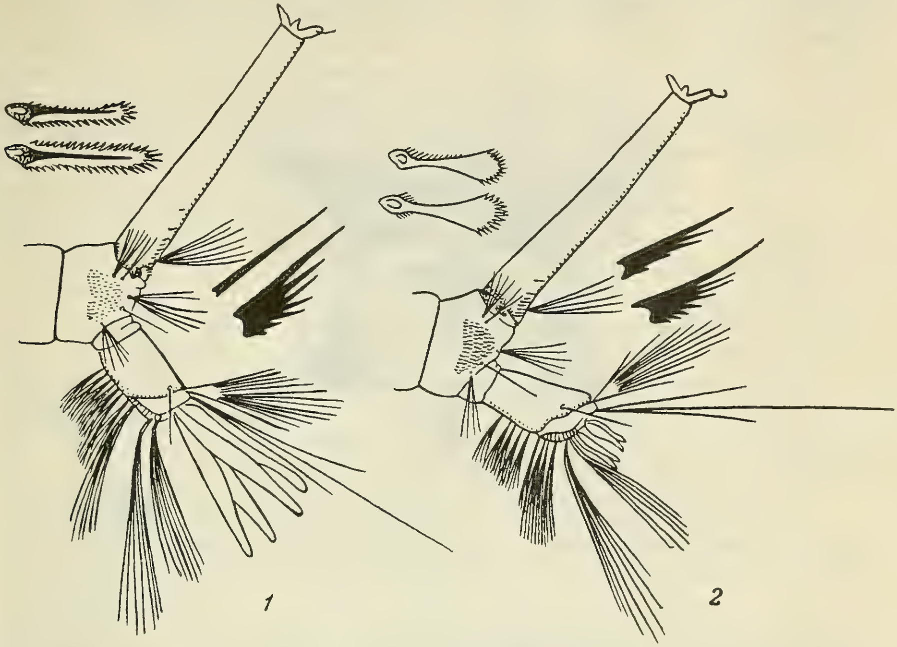

FIGURE 84. 1 – Culiseta ochroptera Peus, posterior end, lateral; 2 – Culiseta morsitans Theob., posterior end, lateral (after Peus).

Fourth-stage larva (Figure 84) large, varying in color from semitransparent to yellowish green and brown, with a pale head which is more than 1.5 times wider than long. Frontal hairs longer than the head, weakly secondarily feathered, outer hairs with 6–7 branches, median and inner hairs with 2–3 branches. Postclypeal hairs situated before the inner frontal hairs, situated closer together, short, simple. Antennae longer than the head, S-shaped, curved, with dark, narrow apical end and base; hair tuft forming a dense fan with 20–25 secondarily feathered branches, situated at $^2/_3$ of the length of the antenna from the base; subapical setae situated near the apex, one of them long. Comb with more than 100 closely arranged, long, narrow scales with slightly widened base and a row of thin spines distally. Siphon (index 5–7) straight, slightly tapering apically, with a pecten of 5–8 long, thin denticles, the distal denticle slightly separated, situated at about $^1/_6$ of the length of the siphon from the base. Tuft with 4–6 branches, $^1/_4$ as long as the siphon, situated at the base. Stigmal plate very characteristic (Figure 85). Main tracheal trunks thin, with round cross section. Last abdominal segment long, the ring-shaped saddle surrounding it;
155 posterior margin with spines on the dorsal side which are absent

anteriorly and laterally. Outer caudal hairs with 3 branches, the median hairs as long as the siphon, the inner hairs forming a fan with 14–17 branches branches. Lateral hair simple, half as long as the saddle. Fin with 13–14 tufts on the common base and about 6 tufts before it, one of them situated in the incision of the saddle, the others on the saddle. Gills lanceolate, nearly half as long as the saddle; the upper pair may be slightly shorter than the lower.

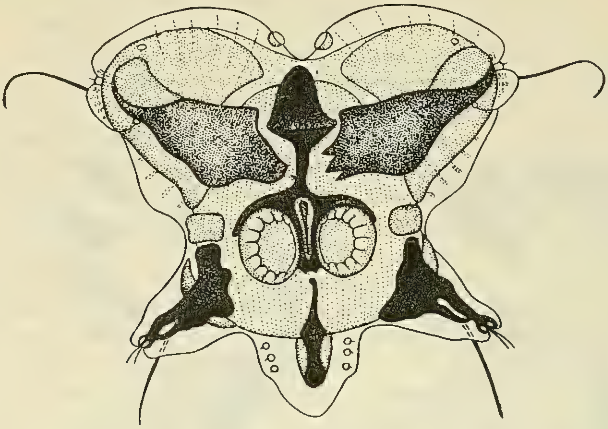

FIGURE 85. Culiseta morsitans Theob. Fourth-stage larva. Stigmal plate.

156 Distribution. European USSR from the Baltic area and Leningrad Region to the Crimea and Northern Caucasus; Central Urals; West Siberia. Europe from Norway, Sweden and Finland to the Mediterranean. North Africa. Southwest Asia.

Biology. The larvae develop in different water bodies, including stagnant and slightly flowing, more or less shaded water bodies with fallen leaves on the bottom. They often occur in temporary water bodies in forests or at their edge. The larvae hibernate in permanent water bodies but die when the water freezes. They occur together with larvae of Anopheles claviger and in spring with larvae of Aedes. The adults are common in forests, mainly of the broadleaved type. During the day they rest among dense grass, on building sites, etc. In the north (Baltic area, Leningrad Region), they are common in late summer and early autumn (second half of July to September). They bite farm animals and man, but feed apparently also on wild animals and probably birds.

7. Culiseta (Culicella) ochroptera Peus, 1935

Head with contiguous whitish scales and with upright black scales; long, dark setae at the margin of the eyes. Palps of female dark brown, sometimes with light scales at apex of 3rd and 4th segment. Palps of male projecting beyond apex of the proboscis for 1.5 times the length of the apical segment; terminal segment not thickened; palps covered mainly with yellowish scales, only the 1st segment, base of the 2nd and a ring at base of 3rd segment dark.

Mesonotum with rust brown or golden brown scales; laterally and at the posterior margin are narrow, crescent-shaped, whitish-brass-colored scales, mainly before the scutellum and also on the scutellum. Such scales sometimes form indistinct longitudinal stripes on the mesonotum. Legs: femora dark anteriorly, pale yellow posteriorly. Tarsi with narrow, light rings at the base of the first 3 segments and sometimes a few light scales at the apex of the segments; light rings on the tarsi often indistinct. Wings with brown scales on the veins, scales sometimes more densely grouped at the base of r_{4+5}, forming a dark spot.

The color of the scales on the abdomen is very variable. The tergites are usually brown with light yellow scales forming transverse stripes at the base and sometimes narrower stripes at the
157 apex. Last tergite completely light. Sternites with light and dark scales arranged as on the tergites. Far Eastern populations have uniformly yellowish (sometimes brown) scales on the tergites. There are also specimens with narrow, basal, light stripes on the tergites or with isolated light scales scattered on the dark background.

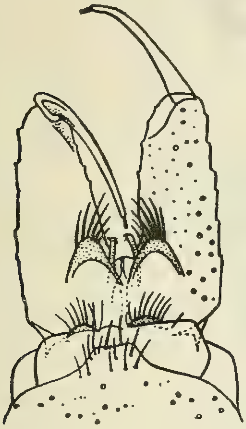

FIGURE 86. Hypopygium of *Culiseta ochroptera* Peus

Hypopygium (Figure 86): lobe of coxite with 3–9 slightly curved spines (strong setae). Posterior margin of 8th sternite with about 8 spines, sometimes without spines. Phallosome usually ovoid, weakly sclerotized.

Fourth-stage larva (Figures 84 and 87) large, light or dark brown, with yellowish brown head and siphon (Monchadskii, 1947). Frontal hairs secondarily feathered; outer hairs with 7–13 branches, $^2/_3$ as long as the antenna, median hairs longer than the antenna, always 2-branched, inner hairs as long as the outer hairs, 5–9-branched, Postclypeal hairs with 2–4 thin branches. Antennae slightly shorter than the head, darkly pigmented at the base and in the tapering apical part, curved where the long subapical setae are situated, distinctly away from the apex; tuft with 20–37 branches. Comb with 60–95 scales, some of them with a longitudinal, dark ridge; the narrowing in the middle, if present, is less distinct than in *C. morsitans*. Siphon long (index 5.7–7.0), slightly tapering apically. Pecten with 2–7 denticles, the 2–3 distal denticles spinelike, more widely separated and with 2–4 rudimentary denticles at the base. Tuft with 5–10 branches, situated at the base, $^1/_4$ – $^1/_3$ as long as the siphon. Branches forming a divergent fascicle, not a fan. Stigmal plate characteristic (Figure 87). Last segment long, saddle surrounding it like a ring. Outer caudal hairs
158 with 2–3 branches, less than $^3/_4$ as long as the siphon; inner hairs forming a fan with 12–23 branches; lateral hair long and simple. Fin with 10–22 tufts on the common base and 6–8 shorter tufts before it, some of them situated on the saddle. Gills narrow, lanceolate, long (1–2.6 times as long as the saddle).

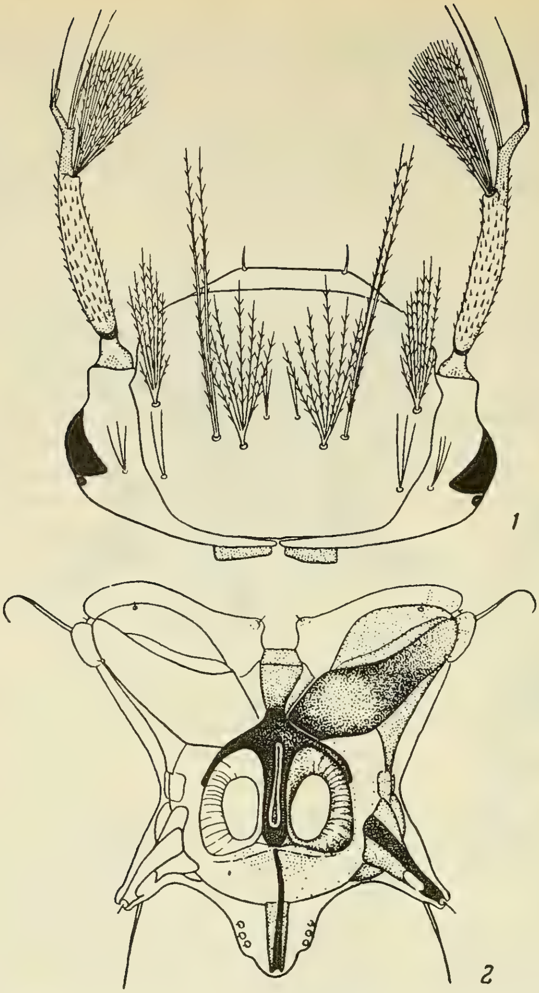

FIGURE 87. Culiseta ochroptera Peus. Fourth-stage larva:

1 — head, dorsal; 2 — stigmal plate.

Note on systematics. A. V. Maslov (1964) considered A. ochroptera as a synonym of C. silvestris Shingarev, 1928, but to judge from Shingarev's incomplete description, "it is certain that the two species are not identical" (Shtakel'berg, 1937). The holotype of C. silvestris is lost and Maslov examined only paratypes. Because of the incomplete original description of C. silvestris, it seems advisable to retain the name C. ochroptera.

Maslov (1964) suggests that the species be divided into four subspecies: C. silvestris silvestris Shing. (Eastern Europe, Urals, West Siberia), C. s. ochroptera Peus (Central Europe, Baltic area),

C. s. amurensis Masl. (Amur area and Maritime Territory), and C. s. minnesotae Barr. (North America). He gives a key to the subspecies based on females, males and larvae; however, this division into subspecies is provisional because of the inadequate study of the species.

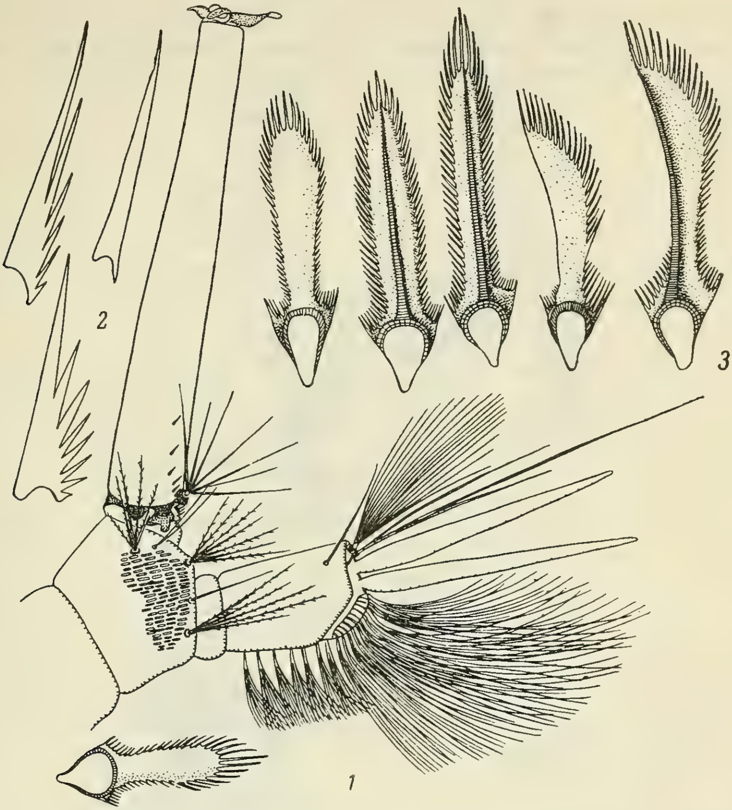

FIGURE 88. Culiseta ochroptera Peus. Fourth-stage larva:

1 — posterior end, lateral; 2 — denticles of pecten; 3 — scales of comb.

Distribution. Forest zone of the Palaearctic, from Western Europe to the Maritime Territory and Northeast China (the Japanese species Culiseta (Culicella) nipponica La Casse and Yamaguti may also refer to C. ochroptera; the species was described from larvae from
159 Hokkaido. The northern and southern boundaries of its distribution have not been determined. In the USSR, C. ochroptera occurs in the Vladimir Region (Saf'yanova, 1960), Urals, West Siberia, and some other areas in addition to the Far East.

Biology. The larvae occur only in large, shallow marshes, in forest clearings, and on the muddy shores of lakes; they apparently hibernate. But in the eastern Ukraine females hibernate (Val'kh, 1959). The mosquitoes are found mainly in wild nature and feed on birds, rarely mammals; they sometimes bite man.

8. **Culiseta** (**Culicella**) **fumipennis** Stephens, 1825

It is closely related to C. morsitans, but differs in the presence of white rings on all tarsal segments, a V-shaped pattern formed by dark scales on most abdominal sternites, and pale scales in the middle of the proboscis.

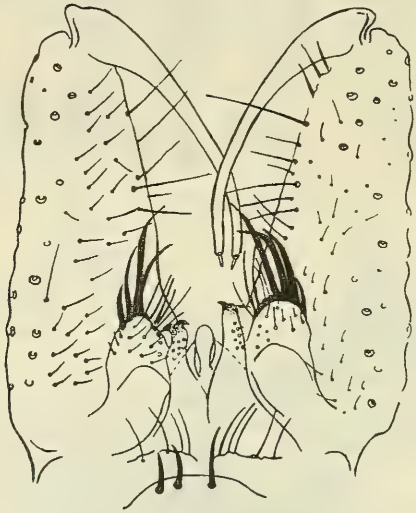

FIGURE 89. Hypopygium of Culiseta fumipennis Steph. (after Natvig)

160 Hypopygium (Figure 89): coxite 3–3.5 times longer than wide at the base. Basal lobe of coxite with 3–4 1strong setae; posterior margin of sternite 8 with a few spines.

Fourth-stage larva (Figure 90) large, semitransparent, greenish or yellowish brown, with a broad head. Frontal hairs secondarily feathered, outer hairs with 5–6 branches, median hairs with 2, inner hairs with 2–4 branches. Antennae longer than the head, with a tuft with 10–13 secondarily feathered branches at the base of the tapering apical third of the antenna. Subapical setae situated some distance from the apex. Comb with 120–160 long, narrow scales which are wider distally and have thin spines at the margin. Siphon wider at the base, tapering at first distinctly and then gradually apically; the length:width index (about 5) of the base does not give a correct picture of the length of the siphon. Pecten with 7–8 well developed and 4–6 rudimentary, densely grouped spaced denticles in an oblique row aroun the base of the hair tuft; the pecten continues in a row of 2–5(3–4) large, smooth, strongly pigmented spines, which are irregularly distributed and absent in the apical third. Hair tuft situated near the base, with 4–5 smooth branches, half as long as the siphon. Stigmal plate with strongly developed, hook-shaped setae on the posterior valves and large hairs on the lateral valves in the form of a partly spread fan with 8–12 branches. Main tracheal trunks narrow, with round cross section.

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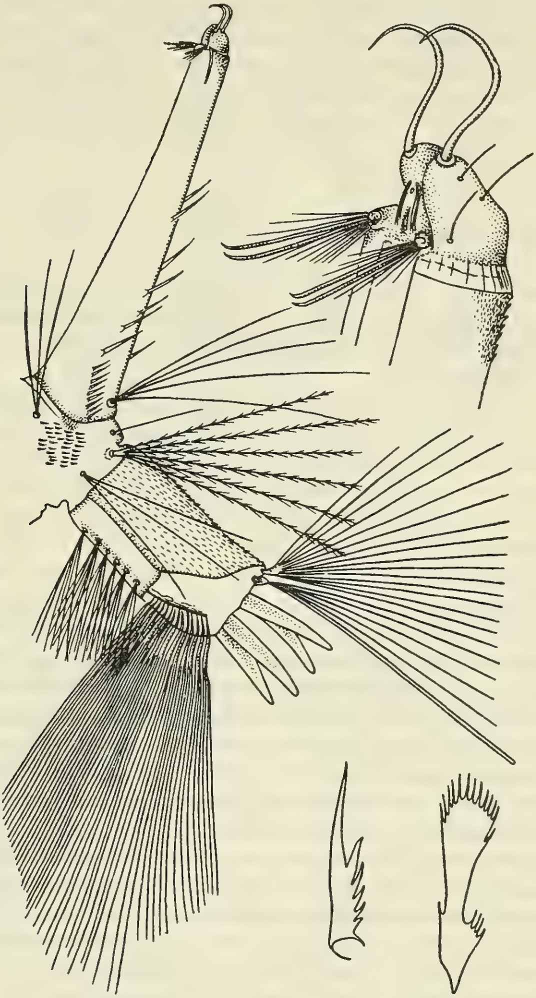

FIGURE 90. Culiseta fumipennis Steph. Fourth-stage larva. Posterior end, lateral (after Séguy).

Last segment long, surrounded by the ring-shaped saddle. Outer caudal hairs with 3 branches, median hairs thick, longer than the siphon, inner caudal hairs forming a fan with 14–15 branches. Fin with 14 tufts and 6 shorter, less branched tufts before it. Gills lanceolate, more than half as long as the last segment.

Distribution. European USSR (Estonia, Leningrad Region, central Urals, Ukrainian Polesie, Northern Caucasus). All records of adult mosquitoes from the USSR need confirmation. Larvae of C. fumipennis have not been found in the USSR. Western Europe to southern Sweden and Norway. Mediterranean, including Algeria.

Biology. The larvae develop in the spring in shallow water with green vegetation and also in water covered with Lemna minor and L. trisulca, often together with larvae of Culiseta morsitans, Culex territans and Culex hortensis (southern parts of the range), rarely with larvae of Anopheles claviger. They feed on plankton and spend most of their time submerged.

9. Culiseta (Culicella) setivalva Maslov, 1937

Closely resembling C. fumipennis in coloration, differing from it in the structure of the hypopygium and particularly in the absence of spines in the middle of the posterior margin of sternite 8 and in the presence of long, strong setae on the coxite.

Head with contiguous whitish scales and upright blackish-brown scales and setae. Proboscis of male light brown, slightly darker toward the base and at the apex, with light yellow scales; palps long, projecting beyond the proboscis for about the length of the apical segment, with brown scales mixed with light scales which form more or less broad rings near the middle
161 of the long segment and at the base of the subapical and apical segment. Hairs on palps of male brownish, especially long in the apical half of the long segment; hairs at base of subapical and apical segment light yellow. Proboscis and palps of female with dark brown scales, with only a few scattered light scales. Mesonotum and scutellum with sparse, narrow, light golden scales; pleurae of thorax with small spots of broad, white scales. Legs (femora and tibiae) dark brown anteriorly, without or with a few light scales, white posteriorly; hind femora sometimes with an anterior longitudinal stripe of light scales; apex of femora and tibiae with yellowish scales; narrow white rings at the base of tarsal segments 1–3 or 1–5. Tarsi of fore legs of male short, distinctly shorter than the tibia; first segment of fore tarsi about as long as or slightly shorter than the other tarsal segments together. Wings with dark brown scales on the veins. Abdomen with dark scales dorsally and stripes of yellowish white scales at the anterior margin of the tergites, about $\frac{1}{3}$ – $\frac{1}{4}$ as long as the tergite; venter with yellowish white scales with more or less numerous dark scales which sometimes form an inverted V as in C. fumipennis.

Hypopygium (Figure 91): sternite 8 without spines at the posterior
162 margin, with 2–4 long, strong setae lateral to the median process (one at each side) and similar setae (about 8), behind the middle of the sternite; coxite with very long, strong setae, 2–3 on the inner side of the coxite; basal lobe small but distinct, with 2 strong setae at the apex; style long and thin.

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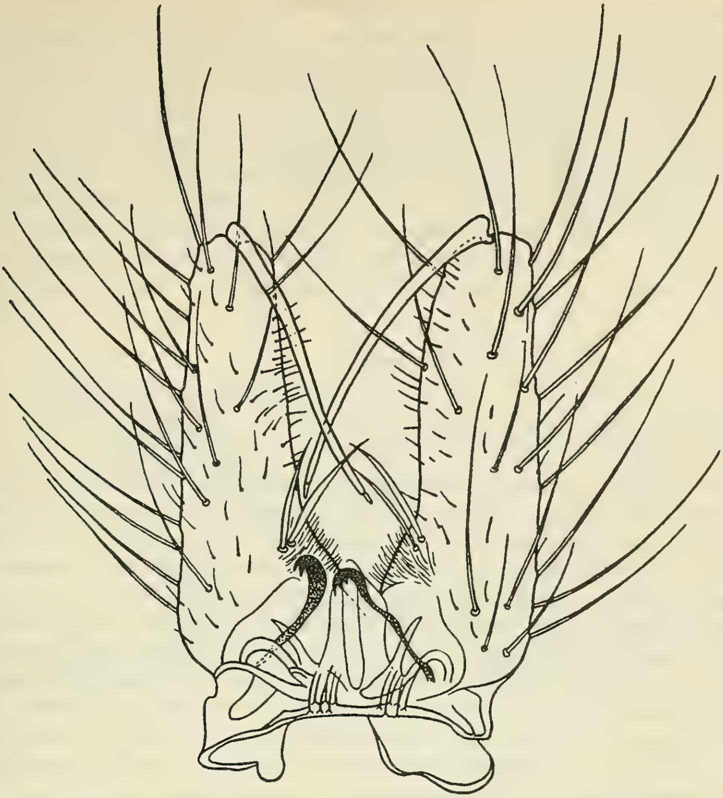

FIGURE 91. Hypopygium of Culiseta setivalva Masl.

Fourth-stage larva resembling that of C. fumipennis, but differing in a number of characters, mainly in the more weakly developed hairs of the posterior (and, possibly, the anterior) end. Comb with over 100 scales. The median hair behind the comb is distinctly shorter than the last abdominal segment. The additional, widely separated distal denticles of the pecten on the siphon are weakly developed; the tuft at the base of the siphon is more strongly developed. On the dorsal side of the posterior margin of the 8th abdominal segment (rudiment of 9th segment) is a narrow, transverse, chitinized arc. The 7–8 tufts before the fin are slightly shorter than the anterior tufts on the common base. Outer caudal hairs with only 3 branches, one hair longer than the others. Gills more than half as long as the last segment.

Distribution. Southern European USSR (south coast of the Crimea), Black Sea coast of the Caucasus, Asia Minor (Anatolia).

Biology. According to Velichkevich (1936), the larvae breed in shallow, silty water bodies overgrown with vegetation, rich in detritus, stagnant or slowly flowing and with a high concentration of calcium (101.2 mg per liter). These water bodies are shaded by trees and shrubs on their banks in summer; they are warmed by the sun in autumn and winter, after leaves have fallen.

One generation per year. Larvae of the 3rd and 4th stage hibernate and pupate at the end of April. Flight begins in early May. The water bodies dry up nearly completely in summer. Eggs deposited in the water or on moist ground are in diapause. In autumn, when rain fills the water bodies, the larvae hatch and reach the 2nd to 4th stage in December, and then enter hibernation. The larvae are found together with larvae of Culiseta morsitans, C. annulata, Culex pipiens, C. territans, C. hortensis, and Anopheles maculipennis. The females bite man and animals during the day and at dusk, particularly in shaded places and among shrubs. They do not fly far from their breeding places, resting in thickets of reeds, Sparganium, in shrubs and tree holes. They do not enter buildings.

6. Genus Mansonia Blanchard

Eyes contiguous or nearly contiguous. Proboscis moderately long, more or less uniformly thick. Palps of male as long as or longer than the proboscis; palps of female short, not more than ¼ as long as the proboscis. Mesonotum with well developed acrostichal and dorsocentral setae. Spiracular setae absent, postspiracular setae present or absent; upper sternopleural setae well developed; upper mesepimeral setae usually present. Legs: 1st segment of hind tarsi shorter than hind tibiae; fore tarsi of male with one larger claw and usually with 2 denticles, the other claw smaller and usually without denticles; claws of female simple; pulvilli
163 absent. Wings with relatively broad scales on the veins. Forks of wings comparatively long. Postalar sclerites with scales. Coxite with well developed basal lobe. Eighth segment of female short and broad; cerci short, not projecting.

The larvae have a very broad head, long antennae with a whiplike apical part, subapical setae situated far from the end and with a strongly developed tuft. Mouth parts of the filtration type. Thorax with strongly developed lateral hair tufts, with chitinized bases on the mesothorax and metathorax. The lateral branches of the main tracheal trunks are widened in the metathorax. The short siphon has valves which are transformed into a piercing apparatus which receives air from the air spaces of aquatic plants. Last segment long, with a ring-shaped saddle surrounding it and with strongly developed fin and caudal hairs.

There are 60 species of Mansonia, most of them from the Tropics of the eastern and western hemispheres. Only three species occur in the Palaearctic: one of them (M. richiardii Fic.) is widely distributed in the USSR, another (M. buxtoni Edw.) is rare in the Mediterranean and occurs in the southwestern USSR, and a tropical species (M. uniformis Theob.) reaches the Palaearctic in the southern islands of Japan (Kyushu, Honshu). The genus is divided into 4 subgenera. The two species in the USSR belong to the subgenus Coquillettidia.

Subgenus Coquillettidia Dyar

Postspiracular setae absent. Seventh abdominal segment of male large, 8th segment not large but distinct, without chitinized hooks. Hypopygium: basal lobe of coxite with a rod-shaped or other appendage that is as long or longer than the lobe; style with a short terminal appendage.

The subgenus contains about 35 species, most of them in tropical Africa, 5 in the Oriental region, 5 in Australia and New Zealand, one in America, and 2 in the Palaearctic.

Females

1 (2). Tarsi with light rings. Proboscis usually with a light ring in the middle. Scales on wings relatively broad .... 1. M. (C.) richiardii Fic.
2 (1). Tarsi without light rings. Proboscis without light ring. Scales on wings relatively narrow .... 2. M. (C.) buxtoni Edw.

Males

1 (2). Style broad at the base, with a constriction in the middle .... 1. M. (C.) richiardii Fic.
2 (1). Style narrower at the base, without a constriction .... 2. M. (C.) buxtoni Edw.

Larvae

1 (2). The dorsal hair of the hairs behind the comb on the 8th abdominal segment with 2–4 branches. Saddle covered with isolated chaetoids, especially on the dorsal side ....1. M. (C.) richiardii Fic. 164
2 (1). The dorsal hair of the hairs behind the comb on the 8th abdominal segment with 5–7 branches. Saddle with shorter chaetoids, forming groups of 2–8 in a row .... 2. M. (C.) buxtoni Edw.

1. Mansonia richardii Ficalbi, 1889

The species is characterized by the broad wing scales and by a white ring on the proboscis and in the middle of the first segment of the hind tarsi in most specimens (Figure 92).

165 Head with yellowish white contiguous and brown upright scales. Proboscis with brown scales, with a ring of whitish scales in the middle which is broader in the female. Palps of female with brown and yellowish white scales; they are usually grouped in the male on the basal part of the segments and form a light ring. Mesonotum with brown and golden scales; scutellum with golden scales; pleurae of thorax with spots of broad, yellowish white scales. Legs: femora and tibiae with brown and yellow scales anteriorly; tarsi brown, usually with broad white rings at the base of the

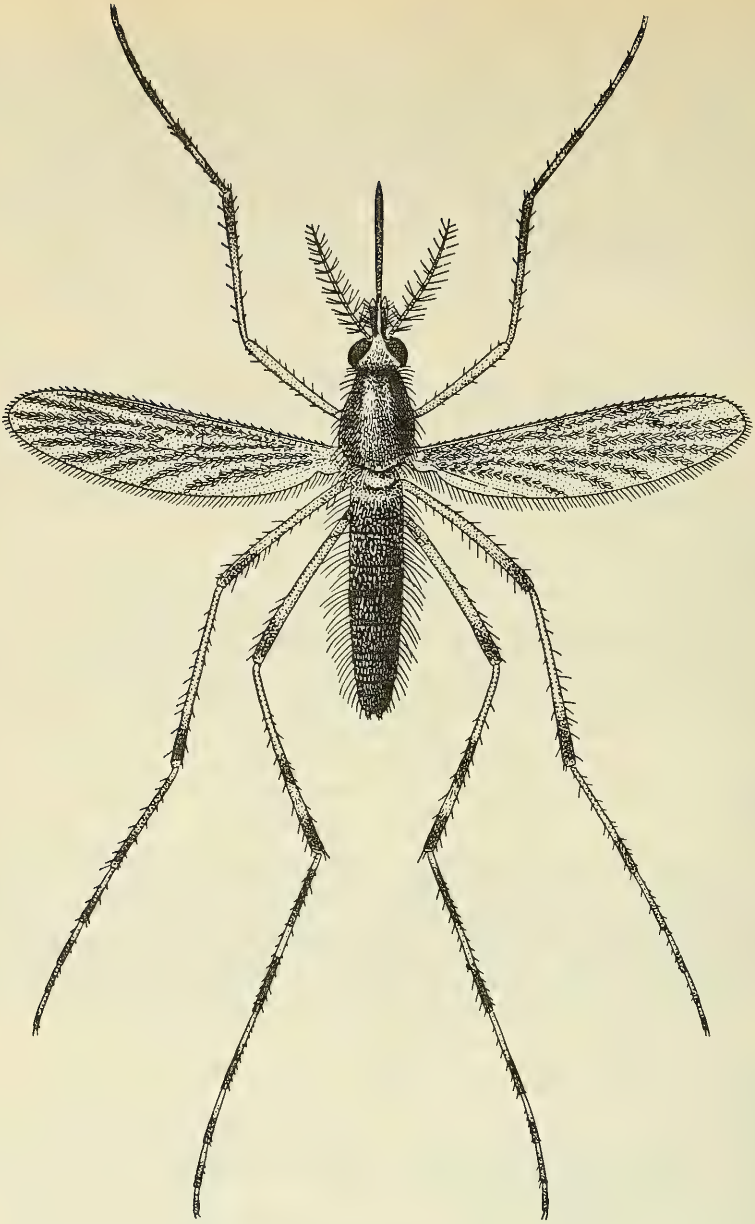

FIGURE 92. Mansonia richiardii Fic.

segments (particularly on the hind tarsi); first segment of hind tarsi with a white ring in the middle, ring rarely indistinct or absent or legs mainly with light scales. Such variation (var. nikolskyi Shing.) are distributed in Middle Asia and Kazakhstan. Claws of male with denticles (2.0; 2.0; 0.0), claws of female simple. Wings slightly gray, veins with relatively broad, white and brown scales. Abdomen with brown scales and triangular spots of yellowish white scales at the sides of the tergites.

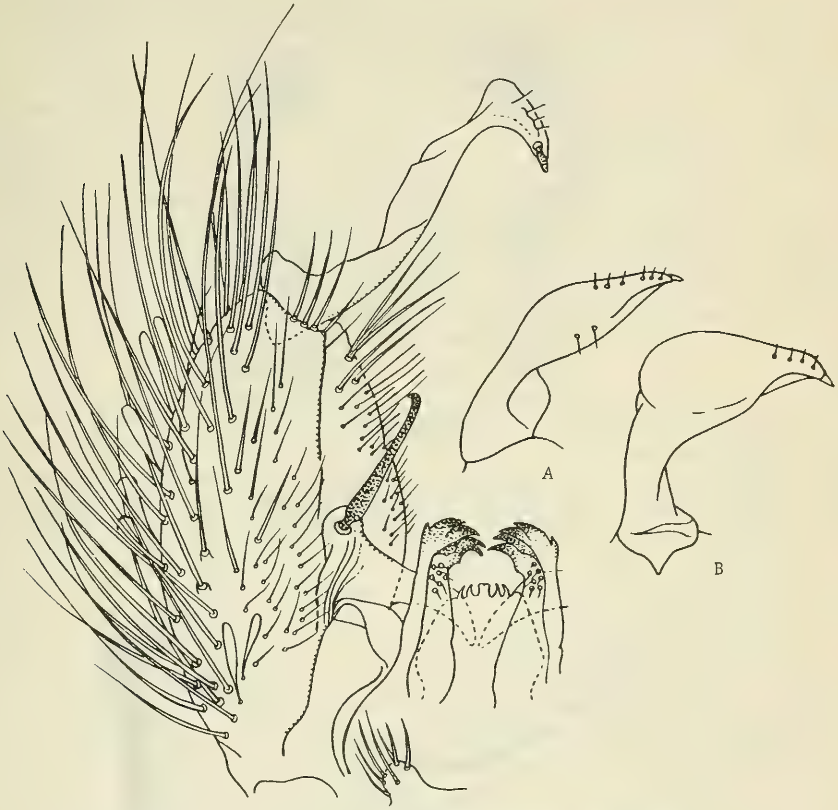

FIGURE 93. Hypopygium of Mansonia richiardii Fic. (after Coe, Freeman and Mattingly). Style of M. richiardii (A) and M. buxtoni Edw. (B) (after Aitken).

Hypopygium (Figure 93): coxite thick, short, with a lobe bearing a strong sclerotized spine with blunt end. Style irregularly widened at the base and 166 in the apical third. Tenth sternite with a few denticles at the apex. Phallosome markedly sclerotized, with denticulate margin. Processes of tergite 9 with 8–10 thin setae. Sternite 8 with a group of 10–15 strong, straight setae situated close together.

Fourth-stage larva (Figure 94) yellowish or yellowish brown. Head broad but not narrowing near the base of the antennae. Outer frontal hairs with 9 branches, the median hairs with 4–5 branches, long and secondarily feathered, inner hairs short, resembling the postclypeal hairs, situated anterior to them; both pairs usually with 5–6 branches. Antennae 1.2–1.8 times longer than the head because of the long terminal part. The subapical setae are situated far from the end; tuft with 15–20 secondarily feathered branches.

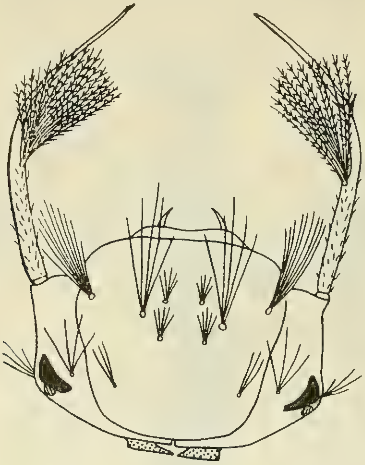

FIGURE 94. Hypopygium of Mansonia richiardii Fic. Fourth-stage larva. Head, dorsal.

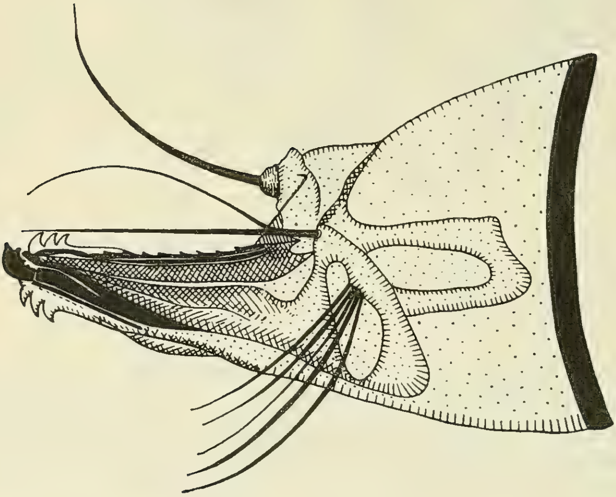

FIGURE 95. Mansonia richiardii Fic. Fourth-stage larva. Siphon, lateral (after Wesenberg-Lund).

Abdomen tapering posteriorly. Comb consisting of an irregular row of scales (more than 25), with a well developed main spine. Hairs behind the comb forming two groups: a dorsal group of 2 hairs situated near the dorsal scales of the comb and a ventral group of 3 hairs situated near its middle; dorsal hair with 2–4 long branches, median hair with 2–3 branches.

167 Siphon very short, in the form of a truncate cone. Auricles at the base, pecten and hair tufts absent. Valves and "stirrup" of stigmal plate forming a piercing apparatus, the hairs of the plate forming long spines.

Last segment elongate, surrounded by the ring-shaped saddle which is wider posteriorly. It is covered, especially on the dorsal side near the posterior margin, with short, isolated chaetoids. Caudal hairs forming a partly spread fan; outer hairs longer than inner hairs. Lateral hair with 2–3 branches. Fin displaced posteriorly, with 10–14 long tufts. Gills lanceolate, with pointed ends, not longer than widest part of last segment.

Distribution. Widely distributed in the western Palaearctic. Recorded from the Leningrad Region (north to Priozersk), Estonia, Latvia, Moscow Region, Urals, Ukraine, Northern Caucasus, Transcaucasia, Middle Asia (Turkmenia, Uzbekistan, Tadzhikistan, Kirghizia), Kazakhstan and the southern part of West Siberia. Widely distributed in Europe, from southern Sweden, Finland, Denmark and England to Italy, Hungary, Bulgaria and Rumania. Southwest Asia (Palestine).

Biology. The larvae occur in different permanent water bodies with rich vegetation (Acorus, Carex, Glyceria, Ranunculus, Sparganium, Typha, etc.) from the air spaces of which they obtain air. They live submerged and move very little. Their specific gravity is higher than that of the water. They remain horizontal during swimming because of the tracheal air sacs. There is one generation per year in the northern part of their distribution, 2–3 generations in the south. The larvae hatch in autumn and usually hibernate in the 3rd or 4th stage. Pupation takes place in May–June. The pupae have modified breathing horns and, like the larvae, pierce the stems and roots of plants at the bottom of the water. Before the mosquito hatches, the end of the horns breaks off and the pupa comes to the surface. In the south (Middle Asia) they breed in large numbers in permanent water bodies in the floodplains of the middle and lower reaches of large rivers, in fresh and slightly saline water, often together with larvae of Anopheles pulcherrimus. The mosquito is an active bloodsucker in Middle Asia and in some areas (floodplains of large rivers) distinctly more numerous than other species of mosquitoes. They bite mainly in wild nature, rarely entering buildings.

2. Mansonia buxtoni Edwards, 1923

It differs from M. richiardii in the absence of rings on the tarsi and the dark proboscis and palps.

Head with yellowish white contiguous scales and brown upright scales. Proboscis and palps with brown scales, which are partly upright. Proboscis about as long as the fore femora. Mesonotum with golden brown scales, lighter before the scutellum and at the base of the wings. Legs: femora and tibiae with dark scales mixed with light scales which form indistinct

longitudinal stripes; apex of femora and tibiae with white scales; tarsi brown; hind tibia distinctly longer than first tarsal segment; claws of female simple. Wings with dark scales, which are narrower than in M. richiardii (but broader than in Culex). Abdomen: tergites with
168 brown scales and distinct, whitish-cream spots at the sides; the spots are connected by narrow stripes at the anterior margin of the tergites on some segments; sternites with light stripes at the base. Hypopygium resembling that of M. richiardii, differing only in the form of the style (Figure 93); it is comparatively broad at the base, without a constriction in the middle, the apical half markedly swollen.

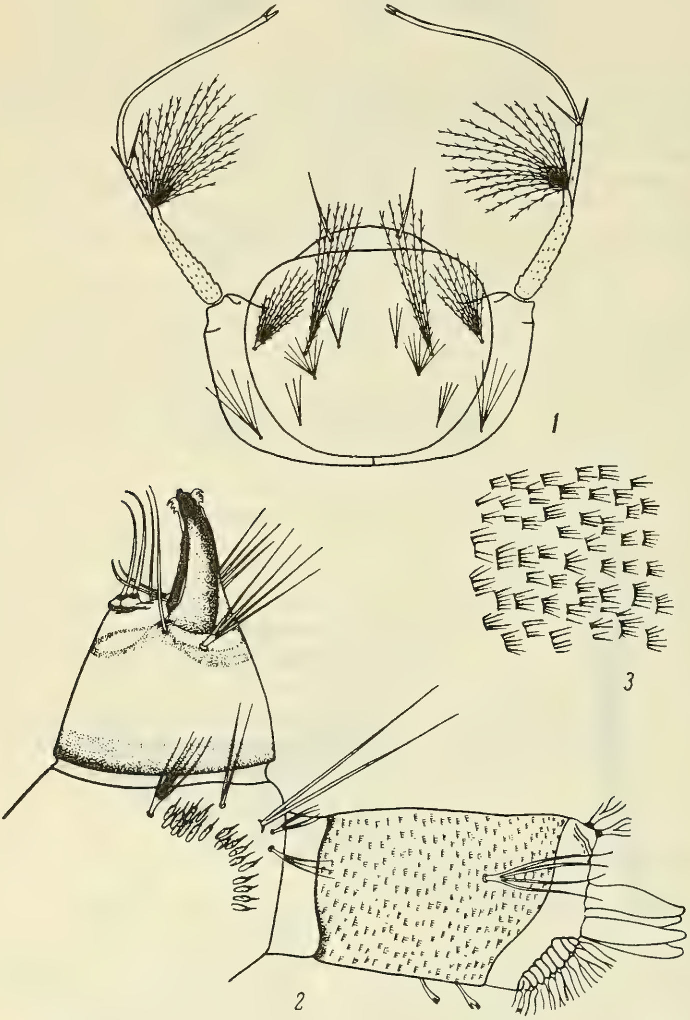

FIGURE 96. Mansonia buxtoni Edw. Fourth-stage larva:

1 — head, dorsal; 2 — posterior end, lateral; 3 — groups of chaetoids on last segment.

Fourth-stage larva (Figure 96) closely resembling that of M. richiardii. It is light green, 5–7 mm long, head 1.4 times wider than long. Frontal hairs: outer hairs moderately long, with 9 secondarily feathered branches, median hairs nearly twice as long, with 5–7 secondarily feathered branches; inner hairs short, with 8 simple branches resembling the postclypeal hairs situated before them. Antennae as in M. richiardii.

169 Comb of 8th abdominal segment with 16–22 scales in an irregular row (partly double dorsally) and with a pointed main spine. The dorsal hair of the hairs behind the comb has 5–7 (average 6) branches, the median hair and intermediate hairs with 2 branches, the latter half as long as the median hair.

The last segment resembles that of M. richiardii but it is covered with rows of short chaetoids in groups of 2–8. Lateral hair with 4 branches.

Distribution. Israel, Syria, Sardinia, Corsica, Morocco. It occurs in the USSR only in the Chernovtsy Region (Gutsevich, Donets, Ezhova and Popov, 1962).

Biology. Little known. The mosquitoes bite man in the open. The larvae occur in water between the roots of Acorus and Typha.

7. Genus Aedes Meigen, 1818

Spiracular setae absent, postspiracular setae present. Claws of female usually with denticles on all legs. Denticles present either on two pairs or on one pair of legs in some species. Pulvilli absent. The first segment of the hind tarsi is shorter than the tibia. Posterior end of abdomen of female more or less pointed, cerci more or less projecting.

Larvae with mouth parts for feeding on plankton or periphyton. An exception are the predaceous larvae of the tropical subgenus Mucidus. Antennae rod-shaped, usually short, with a hair tuft near the middle or basal to it. Median and lateral hairs of prothorax moderately developed. Tracheal air sacs and main tracheal trunks with round cross section absent. Dorsal chitinized plates absent, except the saddle on the last segment. Siphon relatively short (index at most 4), always with a pecten and a pair of hair tufts on the posterior surface, rarely with additional hairs on the anterior side and on the sides of the siphon. Stigmal plate usually with a 2-branched posterior process of the "stirrup."

About 700 species of this large genus have been described. Forty-two species occur in the USSR and form half of the species of mosquitoes in the Soviet Union. Aedes predominates in number of species and specimens in the tundra and in forest belts.

The genus is divided into more than 20 subgenera of which 5 occur in the Palaearctic: Ochlerotatus, Aedimorphus, Finlaya, Stegomyia, and Aedes. The subgenera are distinguished by the structure of the hypopygium, less distinctly by the females.

The larvae are grouped differently than the adults. The larvae of the subgenera Aedes, Ochlerotatus and Aedimorphus are very similar. On the other hand, the larvae of some species of the subgenus Ochlerotatus resemble those of Stegomyia and many larvae of

Stegomyia those of Finlaya. Only a general key of the larvae is therefore given and no special key for the larvae of the different subgenera.

The species of Aedes cause great harm as bloodsuckers and vectors of diseases of man and animals.

170 Key to Species

Females

1 (50). Tarsi with light rings, which are sometimes very narrow, more distinct on the hind tarsi (light rings better visible against a dark background).

2 (13). Each light ring of the tarsi extends to 2 segments: apex of one and base of following segment (Figure 97,A).

3 (6). Wing veins with light and dark scales.

4 (5). Abdomen with a dorsal longitudinal light stripe, sometimes nearly completely covered with light scales . . . . 1. A. (Ochlerotatus) caspius Pall.

a (b). Mesonotum with golden or rust brown scales, with 2 longitudinal light stripes. Wing veins with light and dark scales . . . . A. caspius caspius Pall.

b (a). Mesonotum with a brown longitudinal stripe; lateral parts with silvery gray or cream-colored scales. Light scales on the wing forming groups on the veins . . . . A. caspius dorsalis Mg.

5 (4). Abdomen without longitudinal light stripes. (The species should be determined by the larvae and the males for greater certainty) . . . . 2. A. (Ochlerotatus) mariae Serg.

6 (3). Wing veins with uniformly dark scales.

7 (8). Light rings on tarsi very narrow, present only on hind legs, sometimes also on midlegs. Palps of both sexes with dark scales . . . . 38. A. (Finlaya) alektorovi Stack.

8 (7). Light rings broader, present on all tarsi. Palps of female dark, with white apex, with white rings in the male.

9 (10). Last tarsal segment white. (Mediterranean) . . . . 3. (A. (Ochlerotatus) pulchritarsis Rond.

a (b). Mesonotum without longitudinal light stripe . . . . A. pulchritarsis pulchritarsis Rond.

b (a). Mesonotum with a narrow longitudinal stripe of white scales . . . . A. pulchritarsis asiaticus Edw.

10 (9). Last tarsal segment entirely dark or dark with a light ring at the base. (Far East.)

11 (12). Mesonotum with a large white spot . . . . 37. A. (Finlaya) seoulensis Yam.

12 (11). Mesonotum without a white spot . . . 39. A. (Finlaya) togoi Theob.

13 (2). Light rings present only on base of tarsal segments (Figure 97,B).

14 (15). White rings on tarsi very broad, only apex of segments dark. In addition to contiguous scales there are also dark upright scales on the hind tibiae . . . . 32. A. (Ochlerotatus) kasachstanicus Guts.

15 (14). Light rings on tarsi less broad, not wider than $^2/_3$ of the length of the segment, usually narrower. Hind tibiae without upright scales.

16 (37). Proboscis distinctly longer than fore femora. Scutellum with yellowish or whitish, narrow, curved scales.

17 (20). Cerci short, little projecting. Light spots at sides of abdomen formed by silvery white scales.

18 (19). White rings present only on first 3 segments of hind tarsi . . . . .
. . . . 40. A. (Finlaya) japonicus Theob.

171 19 (18). White rings present on 4 segments of hind tarsi . . . .
. . . . 41. A. (Finlaya) koreicus Edw.

20 (17). Cerci longer, distinctly projecting. Light abdominal scales without silvery sheen.

21 (22). White rings on tarsi very narrow, usually not more than $^1/_4$ of the length of the segment (Figure 97,C) . . . .
. . . . 33. A. (Aedimorphus) vexans Mg.

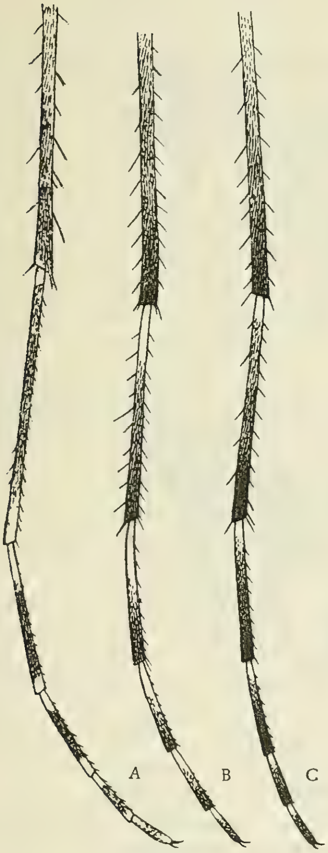

FIGURE 97. Tarsi of Aedes:

A — A. caspius Pall.; B — A. cantans Mg.; C — A. vexans Mg.

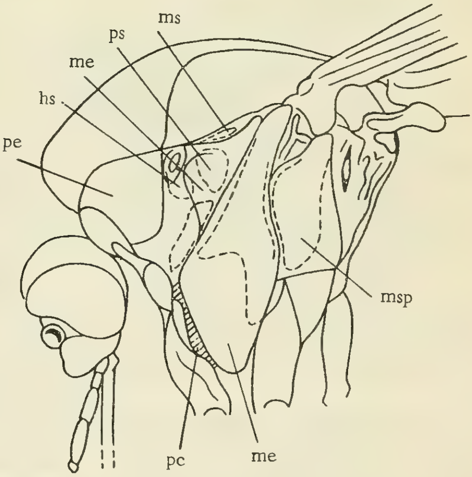

FIGURE 98. Spots of scales on pleurae of thorax of Aedes:

pe — proepimeral; hs — hypostigmal; ps — parastigmal; ms — metastigmal; pc — postcoxal; me — mesepisternal (sternopleural); msp — mesepimeral.

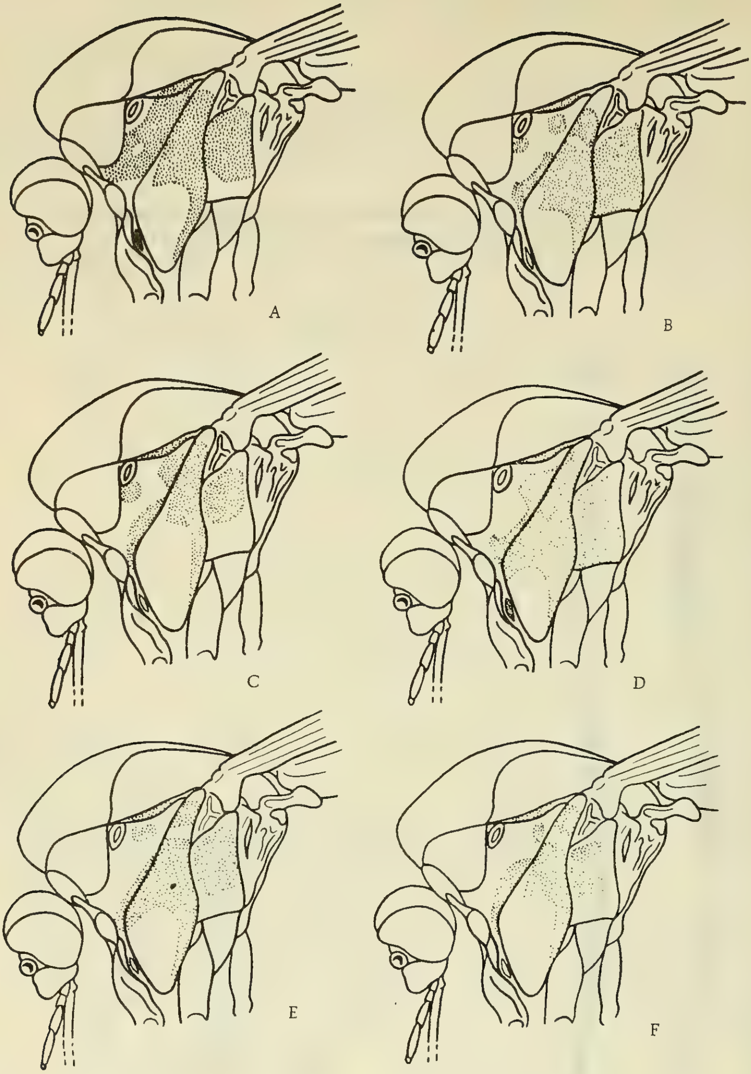

FIGURE 99. Arrangement of spots of scales on pleurae of thorax of *Aedes* (after O.N.Sazonova):

A – *A.cataphylla* Dyar; B – *A.pullatus* Coq.; C – *A.intrudens* Dyar; D – *A.punctor* Kirby; E – *A.nigrinus* Eck.; F – *A.diantaeus* H.D.K.

a (b). Posterior half of abdominal tergites with uniformly dark scales .... A. vexans vexans Mg.

b (a). Tergites with light spots in posterior part of segments, sometimes forming an interrupted longitudinal stripe .... A. vexans nipponii Theob.

22 (21). Light rings on tarsi broader, not less than $^1/_3$ of the length of the middle segment of the hind tarsi (Figure 97,B). The species of the group cantans cannot always be determined with certainty by the females.*

23 (26). Abdomen with light scales dorsally, sometimes mixed with isolated dark scales.

172 24 (25). Females usually ocher yellow. Mesonotum with silvery yellow scales. Pleurae of thorax with cream-colored scales, not differing distinctly in color from the scales on the mesonotum. Lower mesepimeral setae present .... 11. A. (Ochlerotatus) cyprius Ludl.

25 (24). Females yellowish gray. Mesonotum with small, rust brown scales. Pleurae of thorax covered with grayish white scales which differ sharply in color from the dark scales on the mesonotum. Lower mesepimeral setae absent .... 10. A. (Ochlerotatus) flavescens Müll.

173 26 (33). More or less numerous (not isolated) dark scales on the abdominal tergites, dark scales sometimes predominating.

27 (28). Abdomen almost completely with dark scales dorsally, without light transverse stripes; light scales (females) usually forming diffuse spots in the midline of the body. Mesonotum usually with small, bronze or rust-colored scales .... 6. A. (Ochlerotatus) behningi Mart.

174 28 (27). Abdomen with more or less light transverse stripes dorsally, if stripes absent, light scales scattered, not forming spots. Mesonotum of different color, with golden scales and light scales and with a dark longitudinal stripe or with dark brown scales and with indistinct light spots.

29 (32). General coloration comparatively dark. Mesonotum mainly with
dark brown scales or with lighter scales and with a dark longi-
175 tudinal stripe. Pleurae of thorax with white scales. Abdomen
with light transverse stripes dorsally which are usually distinct
on the anterior segments.

30 (31). Mesonotum mainly with chocolate brown scales in small, indistinct spots, sometimes with a longitudinal dark stripe. White rings on middle segments of hind tarsi usually less than half as long as the segment. Claws sharply curved .... 4. A. (Ochlerotatus) cantans Mg.

31 (30). Mesonotum with a more or less distinct dark longitudinal stripe, lateral parts with golden scales. White rings on middle segments of hind tarsi at least half as long as the segment. Claws slightly curved .... 5. A. (Ochlerotatus) riparius D.K.

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* In the determination of the species of the cantans group and particularly of the communis group, the arrangement of spots of scales on the pleurae of the thorax (Figures 98–101) and the form of the claws (Figure 102) are important.

(173)

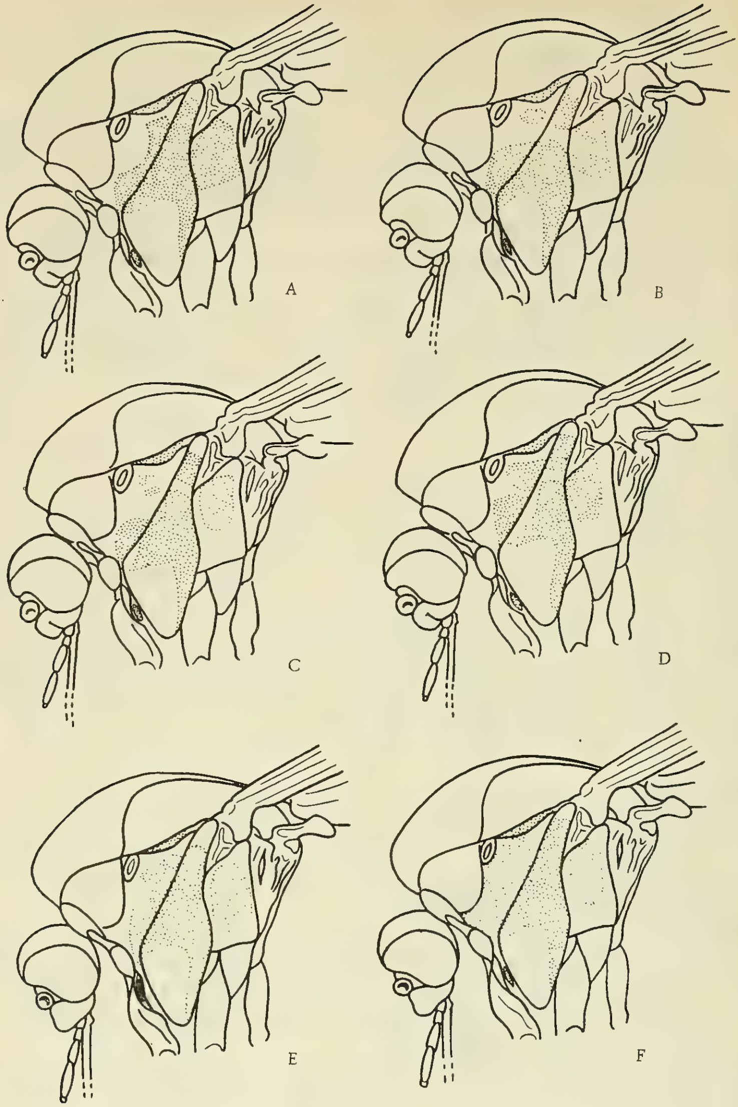

FIGURE 100. Arrangement of spots of scales on pleurae of thorax of Aedes (after O.N.Sazonova):

A – A.behningi Mart.; B – A.beklemishevi Den.; C – A.excrucians Walk.; D – A.riparius D.K.; E – A.cyprius Ludl.; F – A.flavescens Müll.

a (b). Light scales among the dark scales on the wings, proboscis and palps . . . . A. riparius riparius D.K.
b (a). Wings, proboscis and palps with dark scales . . . . A. riparius ater Guts.

32 (29). General coloration lighter. Mesonotum usually with mainly golden or cream-colored scales, sometimes with a dark longitudinal

stripe. Pleurae of thorax usually with yellowish scales. Abdomen often without light stripes dorsally, if stripes are present they are formed by yellowish scales.

(174)

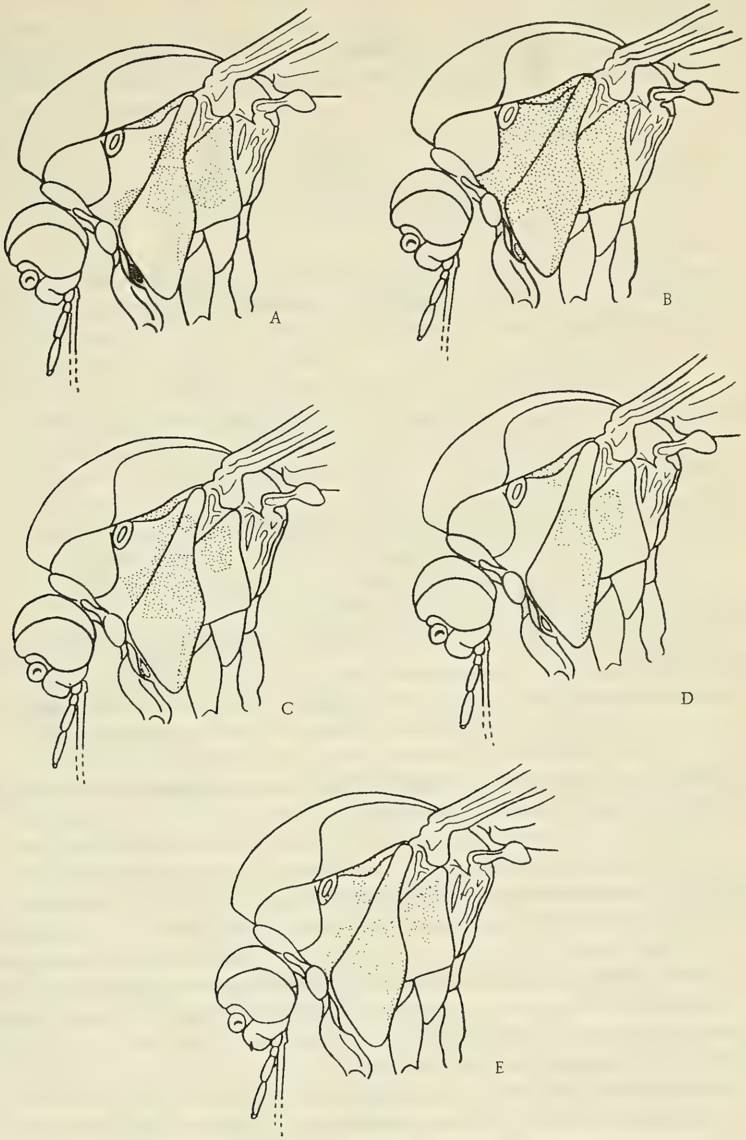

FIGURE 101. Arrangement of spots of scales on pleurae of thorax of Aedes (after O.N. Sazonova):

A – A. impiger Walk.; B – A. caspius dorsalis Mg.; C – A. vexans Mg.; D – A. cinereus Mg.; E – A. geniculatus Ol.

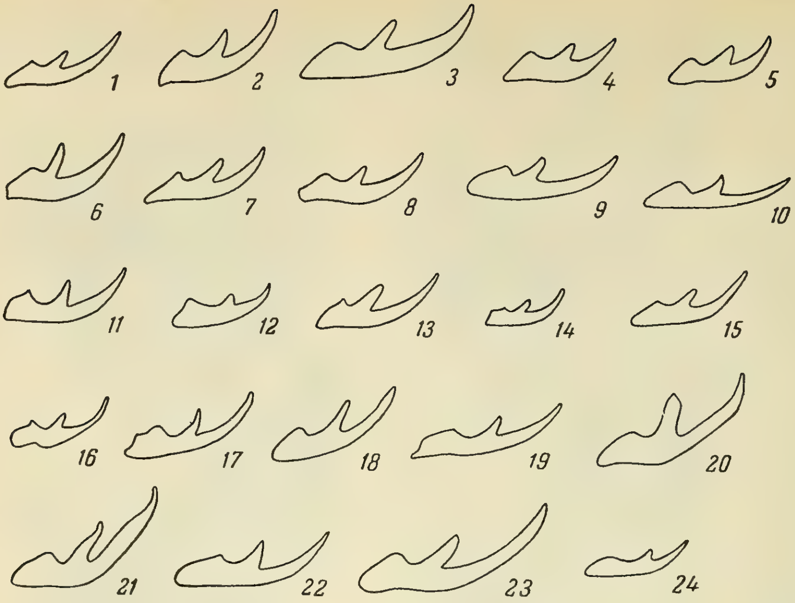

FIGURE 102. Claws of species of Aedes (after O.N.Sazonova):

1 – A.cinereus Mg.; 2 – A.impiger Walk.; 3 – A.nigripes Zett.; 4 – A.cataphylla Dyar; 5 – A.leucomelas Mg.; 6 – A.pullatus Coq.; 7 – A.intrudens Dyar; 8 – A.punctor Kirby; 9 – A.hexodontus Dyar; 10 – A.pionips Dyar; 11 – A.communis Deg.; 12 – A.nigrinus Eck.; 13 – A.diantaeus H.D.K.; 14 – A.sticticus Mg.; 15 – A.caspius dorsalis Mg.; 16 – A.vexans Mg.; 17 – A.behningi Mart.; 18 – A.cantans Mg.; 19 – A.riparius D.K.; 20 – A.beklemishevi Den.; 21 – A.excrucians Walk.; 22 – A.cyprius Ludl.; 23 – A.flavescens Müll.; 24 – A.geniculatus Ol.

176 33 (36). Mesonotum covered mainly with golden scales, without distinct longitudinal dark stripe.

34 (35). Claws sharply curved, large; denticle nearly parallel to apical part of claw . . . . 7. A. (Ochlerotatus) excrucians Walk.

35 (34). Claws less sharply curved, with a large, widely diverging denticle. (The species can be reliably determined only by the larvae) . . . . 8. A. (Ochlerotatus) beklemishevi Don.

36 (33). Mesonotum with a distinct longitudinal dark stripe, lateral parts with grayish yellow scales . . . . 9. A. (Ochlerotatus) annulipes Mg.

37 (16). Proboscis not longer than fore femora. Scales of scutellum broad, straight, silvery white.

38 (41). Mesonotum with snow white spots.

39 (40). Mesonotum with 4 round, white spots in the middle . . . . 44. A. (Stegomyia) vittatus Big.

40 (39). Mesonotum with 2 triangular or semicircular white spots at sides of anterior half . . . . 48. A. (Stegomyia) chemulpoensis Yam.

41 (38). Mesonotum with one or several longitudinal white stripes.

42 (43). Mesonotum with 4 narrow longitudinal stripes, the lateral stripes more distinct, curved in the anterior half .... 42. A. (Stegomyia) aegypti L.

43 (42). Mesonotum with a silvery white median longitudinal stripe.

44 (45). Last segment of hind tarsi moderately or completely dark at the apex .... 45. A. (Stegomyia) galloisi Yam.

45 (44). Last segment of hind tarsi white.

46 (47). Claws of fore and mid-tarsi of female with a denticle (Mediterranean) .... 43. A. (Stegomyia) cretinus Edw.

47 (46). Claws of fore and mid-tarsi of female without a denticle (Far East).

48 (49). A small, light spot at the margin of the mesonotum above the base of the wing, formed by broad, straight, silvery white scales .... 46. A. (Stegomyia) albopictus Sk.

49 (48). An indistinct, light spot above the base of the wing, formed by narrow, curved, whitish or yellowish scales .... 47. A. (Stegomyia) flavopictus Yam.

50 (1). Tarsi without light rings.

51 (96). Proboscis distinctly longer than fore femora.

52 (57). Cerci of female short, little projecting. Light spots on abdomen shining, silvery.

53 (54). Mesonotum with 2 large, silvery white spots, sometimes fused into one spot ..... 36. A. (Finlaya) nipponicus La Casse and Yamag.

54 (53). Mesonotum with a broad, longitudinal dark stripe, without silvery white spots.

55 (56). Scutellum with narrow yellowish scales .... 34. A. (Finlaya) geniculatus Ol.

56 (55). Scutellum with broad white scales .... 35. A. (Finlaya) echinus Edw.

57 (52). Cerci long, distinctly projecting. Light spots on abdomen without silvery sheen.

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58 (69). Light scales present or predominating in apical half of tergites.

59 (62). Scales in dorsal part of proepimeron broad, straight, black. Mesonotum with a broad, longitudinal, dark stripe or with 2 dark stripes close together.

60 (61). Light stripes on abdominal tergites not sharply defined, and not widened in the middle; abdomen sometimes with light and dark scales dorsally, light scales usually predominating .... 13. A. (Ochlerotatus) refiki Med.

61 (60). Light stripes on abdominal tergites often distinct, usually with a process in the midline of the body .... 12. A. (Ochlerotatus) rusticus Rossi.

62 (59). Scales in upper part of proepimeron often narrow, curved, but if straight, yellowish or light brown, not black. Mesonotum usually without dark longitudinal stripe.

63 (66). Light scales on abdominal tergites not forming transverse stripes; abdomen completely covered with light scales dorsally or among them are more or less numerous dark scales, sometimes forming indistinct spots.

64 (65). Postnotum (the tongue-like process behind the scutellum with a group of scales .... 14. A. (Ochlerotatus) lepidonotus Edw.

65 (64). Postnotum without a group of scales .... 15. A. (Ochlerotatus) subdiversus Mart.

66 (63). Abdominal tergites usually with basal stripes of light scales (more or less numerous light scales also in posterior half of tergites).

67 (68). Postcoxal spot of scales absent. Thorax with brown integument. Light scales mixed with dark scales in posterior half of tergites .... 30. A. (Ochlerotatus) detritus Hal.

68 (67). Postcoxal spot of scales present. Thorax with blackish brown integument. Posterior half of tergites with dark scales and more or less numerous light scales (sometimes only a few light scales) .... 31. A. (Ochlerotatus) simanini Guts.

69 (58). Posterior part of tergites with dark scales; light scales forming stripes or spots at base or sides of tergites.

70 (73). Mesonotum with long, dense, black setae. Setae present on entire posterior half of proepimeron.

71 (72). Spot of light scales on sternopleuron extending to anterior angle of sclerite (at base of fore legs). Claws slightly curved, long .... 26. A. (Ochlerotatus) nigripes Zett.

72 (71). Spot of light scales on sternopleuron not extending to the anterior angle. Claws sharply curved .... 27. A. (Ochlerotatus) impiger Walk.

73 (70). Setae of mesonotum less long or dense, often brown or golden. Setae on proepimeron present only at the posterior margin.

74 (77). Fore femora variegated anteriorly, with numerous light and dark scales. Light scales mixed with dark scales in different parts of the wing, especially on the costa and r_1.

75 (76). Proboscis with more or less numerous light scales, especially in
the middle. Numerous light scales scattered on the veins of the
178 wing .... 29. A. (Ochlerotatus) leucomelas Mg.

76 (75). Proboscis with uniformly dark scales. A few light scales only in anterior part of wing .... 28. A. (Ochlerotatus) cataphylla Dyar.

77 (74). Fore femora usually not variegated anteriorly, mainly with dark scales or with a few light scales. Light scales present only at the base of the wing or absent.

78 (81). A small spot of light scales below the anterior spiracle (hypostigmal spot).

79 (80). Spot of white scales on mesoepimeron extending to its lower margin. Lower mesepimeral setae present .... 25. A. (Ochlerotatus) pullatus Coq.

80 (79). Spot of white scales on mesepimeron not extending to its lower margin. Lower mesepimeral setae usually absent .... 24. A. (Ochlerotatus) intrudens Dyar.

81 (78). Hypostigmal spot absent.

82 (83). Spot of white scales on sternopleuron not extending to its anterior angle .... 23. A. (Ochlerotatus) diantaeus H. D. K.

83 (82). Spot of white scales on sternopleuron extending to its anterior angle (at base of fore legs).

84 (91). Spot of white scales on mesepimeron extending to its lower margin. Lower mesepimeral setae present.

85 (86). Postcoxal scales absent (i.e. scales absent on membranous part between sternopleuron and articulation of prothorax with coxae of fore legs . . . . 16. A. (Ochlerotatus) communis Deg.

86 (85). Postcoxal scales present.

87 (88). Base of costa with dark scales. Light stripes of abdominal tergites 2–5 sharply narrowed in the middle . . . . 18. A. (Ochlerotatus) punctor Kirby.

88 (87). More or less numerous light scales usually at base of costa. Light stripes of abdominal tergites 2–5 of uniform width or only slightly narrower in the middle. (It is difficult to distinguish the adults of the last two species, but they can be reliably distinguished by the larvae.)

89 (90). Mesonotum with light, grayish yellow scales, with 2 indistinct longitudinal brown stripes close together . . . . 17. A. (Ochlerotatus) pionips Dyar.

90 (89). Mesonotum with dark scales, often more or less uniformly rust brown . . . . 19. A. (Ochlerotatus) hexodontus Dyar.

91 (84). Spot of white scales on mesepimeron ending distinctly before its lower margin. Lower mesepimeral setae absent.

92 (95). Hind tibiae usually covered mainly with light scales on the outside.

93 (94). Wing veins with dark scales. Light stripes on abdomen markedly narrower in the middle. First segment of flagellum of antennae yellow at the base . . . . 20. A. (Ochlerotatus) sticticus Mg.

94 (93). Light scales present at base of wing. Light stripes on abdomen of more or less uniform width. First segment of flagellum of antennae entirely black . . . . . 21. A. (Ochlerotatus) nigrinus Eck.

179 95 (92). Hind tibiae with dark scales on the outside . . . . 22. A. (Ochlerotatus) hungaricus Mih.

96 (51). Proboscis not longer than fore femora or slightly longer than fore femora (A. aureus).

97 (98). Mesonotum with golden scales and a longitudinal dark stripe. Wings with a large admixture of light scales. Bright golden scales form a large spot on the occiput . . . . 51. A. (? subgenus) aureus Guts.

98 (97). Mesonotum without dark stripe. Wings with dark scales. Occiput without spot of golden scales.

99 (100). Abdominal tergites with white spots at the sides, without light stripes . . . . 50. A. (?Aedes) nobukonis Yam.

100 (99). Abdominal tergites dark or dark with light stripes . . . . 49. A. (Aedes) cinereus Mg.

a (d). Abdomen without light stripes dorsally.

b (c). Scales of mesonotum dark, reddish brown, sometimes with a golden or bronze sheen. Head mainly with dark scales . . . . A. cinereus cinereus Mg.

c (b). Scales of mesonotum lighter, golden brown or yellowish. Head with light, whitish gray scales . . . . A. cinereus rossicus D.G.M.

d (a). Abdomen with light stripes at base of tergites . . . . A. cinereus esoensis Yam.

*Males**

Key to Subgenera

1 (2). Style divided into two branches, a median and a lateral. Palps several times shorter than the proboscis, as in females .... subgenus Aedes Mg. (p.189).
2 (1). Style simple, not divided into two branches. Palps about as long as the proboscis, sometimes slightly longer or slightly shorter.
3 (6). Claspettes present.
4 (5). Coxite with more or less large basal and apical lobes or at least with one of them .... subgenus Ochlerotatus Arr. (p.185).
5 (4). Coxite without lobes (sometimes rudimentary, basal lobe in the form of a small tubercle) ..... subgenus Finlaya Theob. (p.188).
6 (3). Claspettes absent.
7 (8). Appendage of style situated some distance from the apex. Style broadly cylindrical, slightly wider at the apex. Basal lobe forming a flask-shaped formation with hairs at the end. The only species of the subgenus in the USSR – .... A. (Aedimorphus) vexans Mg.
8 (7). Appendage of style situated at the apex or slightly subapical. Style of different form. Lobe situated in middle of coxite .... subgenus Stegomyia Theob. (p.188).

180 Key to Species

Subgenus Ochlerotatus Arribalzaga

1 (8). Basal lobe of coxite with one row of long, lanceolate scales.
2 (3). Style with S-shaped appendage ...... 12. A. (O.) rusticus Rossi.
3 (2). Style with straight or nearly straight appendage.
4 (5). Wing of claspette elongate, transversely striated .... 13. A. (O.) refiki Med.
5 (4). Wing of claspette shorter, not striated.
6 (7). Only one lobe in basal part of coxite, bearing a group of lanceolate scales .... 14. A. (O.) lepidonotus Edw.
7 (6). In addition to the lobe with long, lanceolate scales, there are small lobes with 1–3 long and several slightly shorter setae .... 15. A. (O.) subdiversus Mart.
8 (1). Lanceolate scales on basal lobe of coxite absent.
9 (14). Coxite with 3 large spines on the inside, 2 spines usually situated on the basal lobe.
10 (11). Coxite with a dense tuft of hairs directed inward .... 23. A. (O.) diantaeus H. D. K.
11 (10). Coxite different.
12 (13). Stem of claspette with a finger-shaped process near the middle. Coxite with a distally directed tuft of hairs at the apex .... 24. A. (O.) intrudens Dyar.
13 (12). Stem of claspette without a process. Coxite without a tuft of hairs .... 25. A. (O.) pullatus Coq.

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* The males of A. nobukonis and A. aureus are not known.

NOTE

Footnote on page 187 should read:

* The hypopygium of A. hungaricus Mih (p. 256) is similar. This species differs from A. caspius in the absence of white rings on the tarsi, dark scales on the wings and other characters.

14 (9). Coxite with 1–2 spines on the inside (on the basal lobe) or without spines.

15 (16). Basal lobe of coxite with 2 spines . . . . 1. A. (O.) caspius Pall.*
(Structure of the hypopygium very similar in both subspecies, intermediate forms are common.)
a (b). Basal lobe slightly convex, spines situated close together; anterior spine strongly curved at the apex . . . . A. caspius caspius Pall.
b (a). Basal lobe markedly convex, spines widely separated; anterior spine slightly curved . . . . A. caspius dorsalis Mg.

16 (15). Basal lobe with one spine or without a spine.

17 (24). Apical lobe of coxite weakly developed, sometimes indistinct.

18 (19). Basal lobe very weakly developed, with short, thin setae and hairs, but without spines or large setae . . . . 2. A. (O.) mariae Serg.

19 (18). Basal lobe more or less developed, with long setae, usually one of them distinctly thicker.

20 (21). Apical lobe absent, Basal lobe slightly convex . . . . 3. A. (O.) pulchritarsis Rond.

21 (20). Apical lobe present, small. Basal lobe convex, conical.

22 (23). Coxite with long hairs. Basal lobe without distinct spine. Phallosome strongly sclerotized, bifurcate. Appendages of tergite 9 with 14-20 setae . . . . 26. A. (O.) nigripes Zett. 181

23 (22). Coxite with shorter hairs. Basal lobe with a spine, which is more or less distinct among the setae. Phallosome weakly sclerotized, with 2 denticles. Appendages of tergite 9 with 4–12 setae . . . . 27. A. (O.) impiger Walk.

24 (17). Apical lobe of coxite well developed.

25 (48). Basal lobe of coxite with one spine or with a large seta, which is distinct between the thinner setae and hairs.

26 (29). Wing of claspette narrow, without transparent, plate-shaped widening.

27 (28). Stem of claspette short; wing of claspette usually sclerotized, slightly widened in the middle . . . . . . 18. A. (O.) punctor Kirby.
19. A. (O.) hexodontus Dyar.

28 (27). Stem of claspette long; wing of claspette very narrow, slightly sclerotized . . . . 16. A. (O.) communis Deg.
17. A. (O.) pionips Dyar.

29 (26). Wing of claspette with a transparent, plate-shaped widening, which is sometimes distinct only if the position of the claspette is changed.

30 (33). Coxite with very long hairs directed medially; ends of hairs of both coxites overlapping. Stem of claspette sharply curved.

31 (32). Lobes of tergite 9 usually with 6–10 short, straight setae . . . . 28. A. (O.) cataphylla Dyar.

32 (31). Lobes of tergite 9 usually with 10–15 long setae directed slightly outward . . . . 29. A. (O.) leucomelas Mg.

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* The hypopygium of A. hungaricus Mih (p.256) is similar. This species differs from A caspius in the white rings on the tarsi, dark scales on the wings and other characters.

33 (30). Hairs on inside of coxites usually shorter, their ends usually not overlapping (except in A. detritus). Stem of claspette straight or slightly curved.

34 (37). Apical lobe with broad base (extending proximally to middle of coxite), with short hairs. Wing of claspette short.

35 (36). Distal part of basal lobe tapering, thin . . . 20. A. (O.) sticticus Mg.

36 (35). Distal part of basal lobe broader, rounded . . . . 21. A. (O.) nigrinus Eck.

37 (34). Apical lobe reaching to distal third of coxite, with long hairs. Wing of claspette usually long.

38 (39). Basal lobe narrow, markedly higher than wide at the base. Wing of claspette very broad, not wider than long . . . . 4. A. (O.) cantans Mg.

39 (38). Basal lobe not higher than wide at the base. Wing of claspette narrower, longer than wide.

40 (41). Basal lobe flattened, with short, dense hairs and a thick, markedly sclerotized spine . . . . 10. A. (O.) flavescens Müll.

41 (40). Basal lobe conical, with a spine or a large, moderately thick seta and long hairs.

182 42 (45). Spine of basal lobe well developed, distinct between the setae and hairs. (Tarsi with light rings.)

43 (44). Stem of claspette long, curved . . . . . . 11. A. (O.) cyprius Ludl.

44 (43). Stem of claspette short, straight, but if curved, the transparent widening of the wing begins at a distance from the base of the wing ("manubrium" present) . . . . 5. A. (O.) riparius D. K.

- a (b). Manubrium of wing of claspette short or absent, a transparent widening in the basal and distal part of the wing . . . . A. riparius riparius D. K.
- b (a). Manubrium of wing of claspette about half as long as the wing; a transparent widening present only in apical half of wing of claspette . . . . A. riparius ater Guts.

45 (42). Spine (large seta) of basal lobe not distinct between the smaller setae. (Tarsi without light rings.)

46 (47). Inner surface of coxite with thick, long hairs. Transparent widening of wing of claspette present in middle and at apex of wing. Phallosome ovoid, without a constriction . . . . 30. A. (O.) detritus Hal.

47 (46). Inner surface of coxite with sparse, shorter hairs. Transparent widening of wing of claspette present on a short part of its middle third. Phallosome oblong, with a slight constriction . . . . 31. A. (O.) simanini Guts.

48 (25). Basal lobe without a spine (large seta).

49 (50). Basal lobe conical, about as high as wide at the base . . . . 6. A. (O.) behningi Mart.

50 (49). Basal lobe flattened, markedly wider than high.

51 (52). Basal lobe slightly convex, with long, very dense hairs. Wing of claspette with a small, hook-shaped appendage on the concave side at the base . . . . 32. A. (O.) kasachstanicus Guts.

52 (51). Basal lobe indistinct, flattened, with short hairs. Wing of claspette without hook-shaked appendage at the base.

53 (54). Stem of claspette thin, long, distinctly tapering apically . . . . 7. A. (O.) excrucians Walk.
54 (53). Stem of claspette thicker, not tapering apically . . . . 9. A. (O.) annulipes Mg.

Subgenus Finlaya Theobald

1 (2). Coxite with a tuft of very large scales in distal part of inner surface . . . . 36. A. (F.) nipponicus La Casse and Yamag.
2 (1). Coxite with small scales mainly on the outside.
3 (6). Wing of claspette longer than stem.
4 (5). Wing of claspette much longer than stem. Appendage of style short, $^{1}/_{7}-{}^{1}/_{5}$ as long as the style . . . . . . 39. A. (F.) togoi Theob.
5 (4). Wing of claspette slightly longer than stem. Appendage of style much longer, about $^{1}/_{4}$ as long as the style . . . . 37. A. (F.) seoulensis Yam.
183 6 (3). Wing of claspette not longer than stem.
7 (8). Coxite with a small tubercle with 2 strong setae and a thinner seta on the inner surface at the base . . . . 38. A. (F.) alektorovi Stack.
8 (7). Tubercle with strong setae on inner surface of coxite absent.
9 (12). Lobes of tergite 9 with 2–6 strong setae.
10 (11). Coxite with very long, dense hairs . . . . 35. A. (F.) echinus Edw.
11 (10). Hairs of coxite not long or dense . . . . . 34. A. (F.) geniculatus Ol.
12 (9). Lobes of tergite 9 with 5–10 thin hairs.
13 (14). Lobes of tergite 9 convex, hemispherical. Claw of sternite 10 simple at the apex . . . . 41. A. (F.) koreicus Edw.
14 (13). Lobes of tergite 9 flattened. Claw of sternite 10 bifurcate at the apex . . . . 40. A. (F.) japonicus Theob.

Subgenus Stegomyia Theobald

1 (2). Style flask-shaped, markedly widened at the apex . . . . 44. A. (S.) vittatus Big.
2 (1). Style cylindrical or spindle-shaped.
3 (6). Appendage situated at apex of style. Posterior margin of tergite 9 with an incision.
4 (5). Lobe of coxite rounded, distinctly outlined. Posterior margin of tergite 9 with a shallow, curved incision . . . . 48. A. (S.) chemulpoensis Yam.
5 (4). Lobe of coxite not distinctly outlined. Posterior margin of tergite 9 with a deep incision . . . . 42. A. (S.) aegypti L.
6 (3). Appendage of style situated a small distance from the apex. Posterior margin of tergite 9 convex or with a process.
7 (8). Lobe of coxite transversely elongate . . . 45. A. (S.) galloisi Yam.
8 (7). Lobe of coxite longitudinally elongate.

9 (10). Posterior margin of tergite 9 serrated, curved (Far East) . . . . .
. . . . 47. A. (S.) flavopictus Yam.
(Mediterranean) . . . 43. A. (S.) cretinus Edw.
10 (9). Posterior margin of tergite 9 smooth, with a process in the middle
. . . . 46. A. (S.) albopictus Sk.

Subgenus Aedes Meigen

Subspecies of A. (Aedes) cinereus Meigen

1 (2). Lateral (longer) branch of style bifurcate at the apex . . . .
. . . . A. cinereus cinereus Mg.
2 (1). Lateral branch of style simple or serrated but not bifurcate.
3 (4). Lobe of coxite with double apex . . . . A. cinereus rossicus D. G. M.
4 (3). Lobe of coxite simple, stepped . . . . . . A. cinereus esoensis Yam.

184 Fourth-stage larvae*

1 (2). Antenna distinctly longer than the head . . . .
. . . . A. (Ochlerotatus) diantaeus H. D. K.
2 (1). Antenna shorter than the head.
3 (10). Frontal hairs situated in one curved row.
4 (5). Frontal hairs not displaced toward anterior margin of head, situated in middle of frontoclypeus. Comb on 8th abdominal segment with a few scales (to 20) with a pointed main spine. Distal denticles of pecten more widely separated, reaching beyond middle of the siphon; hair tuft with 3–5 short branches situated near the apex . . . . Subgenus Aedes Meig.
a. Typical larvae: with the characters of the subgenus . . . .
. . . . A. (Aedes) cinereus cinereus Meig.
b. Typical larvae: in addition to the subapical setae, there are 2 pairs of thin, short hairs with 2–5 branches on the anterior side of the siphon . . . . A. (Aedes) cinereus rossicus D. G. M.
c. Typical larvae with 4 pairs of additional, very short and thin hairs at lateral surfaces at apex of siphon . . . .
. . . . A. (Aedes) cinereus esoensis Yam.
5 (4). Frontal hairs displaced toward anterior margin of frontoclypeus. Comb on 8th abdominal segment with 40–50 scales without a main spine.
6 (7). Siphon short (index about 2), as long as the last segment; hair tuft situated near apex of siphon. Gills short, bluntly conical . . . . .
. . . . A. (Finlaya) togoi Theob.
7 (6). Siphon longer (index about 3), distinctly longer than the last segment; hair tuft situated near the middle. Gills as long as the last abdominal segment or longer, lanceolate.

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* The larvae of A. simanini and A. kasachstanicus are described on pp. 279 and 283, those of A. aureus and A. nobukonis are unknown.

8 (9). Denticles of pecten evenly spaced, not more than 2 distal denticles extending beyond the hair tuft . . . . . . A. (Finlaya) koreicus Edw.

9 (8). Distal denticles of pecten (1–4) more widely spaced, forming large spines with a more acute angle to the longitudinal axis of the siphon . . . . A. (Finlaya) japonicus Theob.

10 (3). Frontal hairs forming a triangle on each side, median hairs situated anterior to the inner hairs.

11 (12). Median and inner frontal hairs displaced toward anterior margin of head; postclypeal hairs as long as the frontal hairs, situated between the median hairs; all hairs strongly branched. Comb with 8–15 scales arranged in one row, with a pointed main spine . . . . A. (Finlaya) nipponicus La Casse and Yamag.

12 (11). Median and inner frontal hairs not displaced toward anterior margin of head; postclypeal hairs much shorter than frontal hairs, if not shorter, frontal hairs weakly branched.

13 (26). Auricles absent at base of siphon. Antennae with a small, simple hair, short, without spines or, rarely (A. vittatus) spines very weakly developed . . . . subgenus Stegomyia Theob.

185 14 (19). Outer frontal hairs simple.

15 (16). Hairs of body, including lateral hair of last segment, stellate. Gills sausage-shaped, 5 times as long as the saddle . . . . A. (Stegomyia) chemulpoensis Yam.

16 (15). Hairs of body branched in one plane. Gills at most 3 times as long as the saddle.

17 (18). Scales of comb, in addition to the main spine, with 2–6 or more spines at the sides of the base, 1–2 spines large, sometimes as large as the main spine. Additional hairs at sides of siphon absent . . . . A. (Stegomyia) aegypti L.

18 (17). Scales of comb without large spines at sides of base of main spine, with only a row of thin, short setae. One hair at sides of siphon, in addition to the tuft, which is as long as the tuft . . . . A. (Stegomyia) cretinus Edw.

19 (14). Outer frontal hairs with at least 2–3 branches.

20 (21). Pecten about $^2/_3$ as long as the siphon. In addition to the pecten there is a large, smooth spine near the apex. The hair on the siphon is situated between the spine and the distal denticle of the pecten . . . . A. (Stegomyia) vittatus Big.

21 (20). Pecten not more than half as long as the siphon, without a larger spine near the apex.

22 (23). Gills 1.2–1.6 times as long as the siphon. Postclypeal hairs only slightly shorter than the frontal hairs, strongly branched, with 9–10 branches. Lateral hair on last segment with 2–4 short branches . . . . A. (Stegomyia) galloisi Yam.

23 (22). Gills shorter than siphon. Postclypeal hairs distinctly shorter than the frontal hairs, weakly branched, with 2–5 branches. Lateral hair with 2 longer branches of different length.

24 (25). Hairs of body stellate . . . . A. (Stegomyia) flavopictus Yam.

25 (24). Hairs of body branched in one plane . . . . A. (Stegomyia) albopictus Skuse.

26 (13). Auricles well developed at base of siphon. Antennae different, usually with distinct spines, rarely smooth, with a simple or, usually, a branched hair.

27 (28). Median frontal hairs very long, longer than the head, twice as long as the branched inner hairs. Gills long, pointed at the end, the shorter lower pair as long as the siphon . . . . A. (Finlaya) alektorovi Stack.

28 (27). Median frontal hairs about as long as the inner hairs. Gills of varying length.

29 (28). Antennae smooth, without spines. Gills longer than the saddle.

30 (35). Hair tuft on antenna in the form of a simple hair. Denticles of pecten in form of long, pointed, equally spaced spines.

31 (32). Comb with 55–60 scales, forming an irregularly triangular spot. All frontal hairs strongly branched, with 5 branches. Gills sausage-shaped, upper pair longer than the siphon, lower pair shorter . . . . A. (Finlaya) seoulensis Yam.

32 (31). Comb with 11–18 scales in one, curved row. Frontal hairs weakly
186 branched, with 1–4 branches. Upper pair of gills not as long as siphon, lower pair distinctly shorter.

33 (34). Pecten $\frac{1}{4}-\frac{2}{5}$ as long as the siphon. Hairs of body strongly developed, stellate, with a few, thinner branches . . . . A. (Finlaya) geniculatus Ol.

34 (33). Pecten at least half as long as the siphon. Hairs of body strongly developed, stellate, with more numerous thicker branches . . . . A. (Finlaya) echinus Edw.

35 (30). Hair tuft of antenna with 2–4 short branches. Denticles of pecten short, not spinelike, with a broad base.

36 (37). Siphon 4–5 times longer than wide at the base, base 1.4–1.5 times wider than apex, slightly but uniformly tapering toward the apex. Gills sausage-shaped, with rounded ends; usually as long as the siphon . . . . . A. (Ochlerotatus) pulchritarsis pulchritarsis Rond.

37 (36). Siphon 3.0–3.5 times longer than wide at the base, base 1.5 times wider than apex, strongly tapering toward the apex. Gills sausage-shaped, usually twice as long as the siphon . . . . A. (Ochlerotatus) pulchritarsis asiaticus Edw.

38 (29). Antennae with sparse spines. If the spines are weakly developed (A. mariae), the gills are very short and spherical.

39 (46). On the anterior surface of the siphon, in addition to the subapical setae, are 2–3 pairs of coarse, well developed hairs and on the lateral surface, in addition to the tuft, is a pair of thin lateral hairs near the distal denticles of the pecten.

40 (43). Denticles of pecten extending beyond hair tuft of siphon.

41 (42). Hair tuft of siphon with 6–8 branches. Distal denticle of pecten not extending to the apical third of the siphon . . . . A. (Ochlerotatus) rusticus Rossi.

42 (41). Hair tuft of siphon in the form of a long, simple hair. Distal denticle of pecten situated in apical third of siphon, nearly at its end . . . . A. (Ochlerotatus) subdiversus Mart.

43 (40). Distal denticles of pecten not extending beyond the hair tuft of the siphon.

44 (45). Three pairs of hairs on anterior surface of siphon. The ventral of the hairs behind the comb is the longest . . . . A. (Ochlerotatus) lepidonotus Edw.

46 (39). Hairs on anterior surface of siphon, except the subapical setae, absent, only the tuft present on the sides.

47 (50). Distal denticles of pecten widely spaced, extending beyond hair tuft of siphon.

48 (49). Saddle surrounding last abdominal segment like a ring . . . . A. (Ochlerotatus) nigripes Zett.

49 (48). Saddle of last abdominal segment extending only beyond middle of
187 sides . . . . A. (Ochlerotatus) cataphylla Dyar.

50 (47). Distal denticles of pecten not extending beyond hair tuft.

51 (72). Four to six shorter tufts before the common base of the fin. Hair tuft in middle of siphon (except in A. mariae, which has a very short siphon), at least as long as the width of the siphon where the tuft is situated.

52 (53). Whole surface of body with small dark spines in dense rows. Head and long siphon (index 4–5) ocher yellow; pecten with 2–3 larger, widely separated denticles . . . . A. (Ochlerotatus) cyprius Ludl.

53 (52). Surface of body bare, without small spines.

54 (57). Comb on 8th abdominal segment usually with 6–12 scales.

55 (56). Scales of comb arranged in one irregular, often curved row. Median and inner frontal hairs with 2–3 branches. Index of siphon 3.5–4.0 . . . . A. (Ochlerotatus) riparius Dyar and Knab.

56 (55). Scales of comb arranged in 2 (rarely 3) irregular rows. Median and inner frontal hairs simple. Index of siphon 2.0 . . . . A. (Ochlerotatus) nigrinus Eck.

57 (54). Comb on 8th abdominal segment with 15–45 scales.

58 (59). Saddle of last abdominal segment weakly developed, not completely covering it dorsally and not extending beyond middle of sides. Gills short, spherical. Index of siphon at most 2 . . . . A. (Ochlerotatus) mariae Ed. and Et. Serg.

59 (58). Saddle well developed. Gills at least half as long as the saddle. Index of siphon at least 3.

60 (63). Hairs at apex of posterior valves of stigmal plate hook-shaped and thickened.

61 (62). Comb with 30–40 (usually 32–36) scales. Postclypeal hairs with 2–3 thin, short branches. Hairs at apex of posterior valves of stigmal plate strongly thickened . . . . A. (Ochlerotatus) excrucians Walk.

62 (61). Comb with 20–28 (average 24) scales. Postclypeal hairs with 6–8 thin, short branches. Hairs at apex of posterior valves of stigmal plate less thick . . . . . . A. (Ochlerotatus) behningi Mart.

63 (60). Hairs at apex of posterior valves of stigmal plate of the usual form: slightly curved, not thickened.

64 (67). Distal denticles of pecten widely spaced.

65 (66). The distal 1–3 denticles of the pecten situated beyond the middle of the siphon. Hair tuft with 2–4 branches . . . . A. (Ochlerotatus) beklemishevi Den.

66 (65). Distal denticles of pecten distinctly not reaching middle of siphon. Hair tuft with 4–7 (usually 5–6) branches . . . . A. (Ochlerotatus) flavescens Müll. (part).

67 (64). Distal denticles of pecten not widely spaced, space between the last 2 denticles usually as long as the space between the preceding 2 denticles.

68 (69). Six or seven shorter tufts before the fin, not situated on the common base . . . . A. (Ochlerotatus) flavescens Müll. (part).

69 (68). Four or five shorter tufts before the fin, not situated on the common base.

70 (71). Fin with 18–19 tufts situated on the common base. Posterior
188 appendage of stigmal plate, in addition to the usual 2 branches, with a different median branch between them . . . . A. (Ochlerotatus) cantans Meig.

71 (70). Fin with at most 16 tufts situated on the common base. Posterior appendage of stigmal plate of the form normal for the subgenus . . . . A. (Ochlerotatus) annulipes Meig.

72 (51). At most 3 tufts not situated on the common base before the fin. If there are 4 tufts before the fin (A. vexans), the hair tuft on the siphon is short, shorter than the width of the siphon at its position, situated at the beginning of the apical third.

73 (78). Gills usually shorter than saddle, rarely only $^1/_3$ of its length, not pigmented.

74 (75). All scales of the comb without a long main spine, with a row of spines at the margin, the apical spine the longest. "Stirrup" of stigmal plate without processes to the spiracles, markedly displaced posteriorly to between the posterior valves. Median frontal hairs with 1–2 branches, inner hairs with 2–3 branches. Gills spherical. A. (Ochlerotatus) detritus Hal.

75 (74). At least some scales of the comb with a long main spine. "Stirrup" of stigmal plate with processes to the spiracles, situated in the middle. Median and inner frontal hairs usually simple. Gills oblong, at least $^1/_3$ as long as the saddle.

76 (77). Tufts of fin branched far from the base: length of single stem of median tufts of fin 1.5–2 times as long as the lateral processes of the base. Some scales of the comb near the ventral side have a long, main spine, the others have 2–3 longer spines at the apex and 2–3 shorter spines at the sides of the base . . . . A. (Ochlerotatus) leucomelas Meig.

77 (76). Tufts of fin branched from near the base: single stem not longer than the lateral processes of the base. Scales of comb with a more or less distinct main spine, isolated in any part of the comb . . . . A. (Ochlerotatus) caspius Pall.

a. Hair tuft on siphon situated beyond the middle, nearer to the apex, with 5–10 branches. Inner caudal hairs with 12–15 branches. Median hair behind the comb with 7–14 branches . . . . A. (Ochlerotatus) caspius caspius Pall.

b. Hair tuft on siphon situated near the middle, with 3–5 (rarely more) branches. Inner caudal hairs with 4–12 branches. Median hair behind the comb with 5–8 branches . . . . A. (Ochlerotatus) caspius dorsalis Meig.

78 (73). Gills at most 1.5 times as long as the saddle, often pigmented.

79 (84). More than 40 scales in the comb; all or nearly all scales without a main spine, with a row of small spines at the margin.

80 (81). Median and inner frontal hairs simple, rarely one or two hairs with 2–3 branches .... A. (Ochlerotatus) communis De Geer.

81 (80). Median and inner hairs with 3–7 branches.

82 (83). Antennae thin, long, about ⅔ as long as the head or slightly longer. All scales of comb without a main spine .... A. (Ochlerotatus) pionips Dyar.

189 83 (82). Antennae thicker and shorter, about half as long as the head. Some scales of comb with a weak main spine .... A. (Ochlerotatus) pullatus Coq.

84 (79). Comb with less than 30 scales.

85 (88). Saddle ring-shaped, surrounding the last segment, or there is a narrow slit on the ventral side between the margins of the saddle.

86 (87). Comb with 10–20 scales, scales small, 0.07–0.08 mm .... A. (Ochlerotatus) punctor Kirby.

87 (86). Comb with 5–9 scales; scales larger, 0.11–0.13 mm .... A. (Ochlerotatus) hexodontus Dyar.

88 (85). Saddle not surrounding the last abdominal segment completely, only extending to the lower margin of the sides.

89 (92). Inner frontal hairs simple. Distal denticles of pecten not widely spaced.

90 (91). Median frontal hairs simple. Comb with 7–16 (average 13–14) scales. Gills pigmented ..... A. (Ochlerotatus) impiger Walk.

91 (90). Median frontal hairs with 2 branches. Comb with 16–24 (usually 20) scales. Gills not pigmented .... A. (Ochlerotatus) hungaricus Mih.

92 (89). Inner frontal hairs with 2–5 branches.

93 (96). Distal denticles of pecten (1–3) always widely spaced, distinctly larger than the others.

94 (95). Hair tuft situated beyond the middle of the siphon, always distal to the distal denticle of the pecten, with 3–8 (usually 4–6) thin branches, shorter than the width of the siphon at its position .... A. (Aedimorphus) vexans Meig.

95 (94). Hair tuft situated in the middle or slightly beyond the middle of the siphon, with 3–8 (usually 4–6) branches, as long as the width of the siphon at its position or longer. If there are more than 2 widely spaced denticles, the tuft is situated between them .... A. (Ochlerotatus) intrudens Dyar.

96 (93). Denticles of pecten equally spaced; one of the distal denticles may be rarely slightly separated from the others. Comb with 16–27 (usually 22–24) scales .... A. (Ochlerotatus) sticticus Meig.

1. Subgenus Ochlerotatus L. Arribalzaga*

Hypopygium: coxite with a basal and an apical lobe, or at least with one lobe; style simple, not bifurcate; appendage of style situated at the

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* See also p. 283.

apex; claspettes present; phallosome simple (not divided into 2 plates). Palps of male slightly longer than or as long as the proboscis, rarely slightly shorter, usually slightly thickened on the 3rd and 4th or 3rd and 5th segments. Female: abdomen tapering posteriorly, cerci distinctly projecting; proboscis distinctly longer than fore femora.

The females are very difficult to determine. The specimens have to be well preserved and undamaged. Determination is sometimes possible only by the males or the larvae. An important systematic character is the arrangement of the spots of scales on the pleurae of the thorax (Peus, 1933).
190 The form of the claws is important in some species (Vockeroth, 1950). Sazonova (1958) mentions many useful characters. She gave a key to the females of species of Aedes of the forest zone.

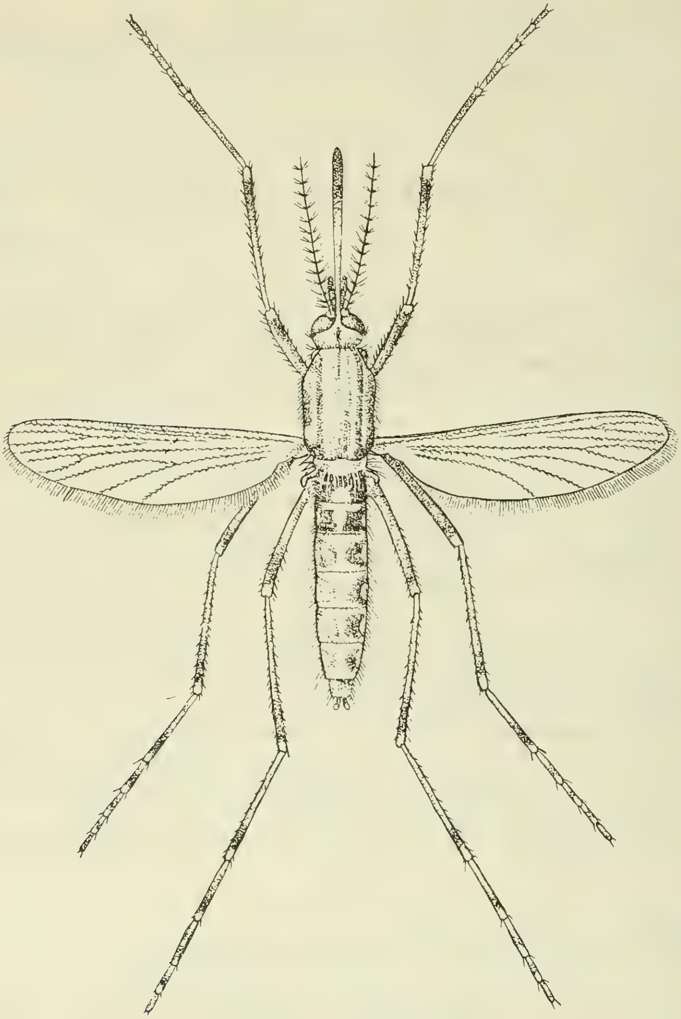

FIGURE 103. Aedes caspius caspius Pall.

The subgenus contains about 140 species distributed mainly in the Palaearctic and Nearctic. Twenty-nine species occur in the USSR. The subgenus Ochlerotatus is characteristic for the forest zone and tundra. The distribution of some species extends to 75–78°N. The species of Ochlerotatus are active bloodsuckers and have an important role in the spread of tularemia and virus infections.

The Palaearctic species of Ochlerotatus may be divided into 4 groups according to the adults, named after one of the series: caspius,
191 cantans, rusticus, communis. The first two groups have light rings on the tarsi (Figure 97), the other two groups do not.

caspius group

Tarsi with white rings on the base and apex of the segments; the borders of the segments are visible on the white rings (Figure 103). The hypopygium is characterized by the weak development or absence of an apical lobe on the coxite, which, however, is also the case in some species of the other groups. .

Three Palaearctic species belong to the caspius group.

1. Aedes (Ochlerotatus) caspius Pallas, 1771

This species is very variable in coloration and is represented in the Palaearctic by two subspecies, one of which, A. c. caspius, occurs in more southern and dry regions, and the other, A. c. dorsalis, in more northern and humid regions. Intermediate forms occur in the Far East, Siberia, Kazakhstan and in some parts of the European USSR.

Head with white and yellowish brown scales dorsally. Proboscis and palps with brown and white scales in varying numbers. The coloration of the thorax and wings of the two subspecies differs. Tarsi with white or cream-colored rings at the base and apex of the segments; light rings sometimes indistinct. Abdomen with indistinct light transverse stripes and a light longitudinal stripe which may not be present on all segments. Light scales usually predominate on the abdomen. There are sometimes only dark spots at the sides of the tergites; the abdomen is rarely completely covered with light scales.

Hypopygium (Figure 104): basal lobe of coxite with 2 spines, one of them longer and curved, the other shorter and straight. Wings of claspette narrow, without transparent widening.

The larvae of the two subspecies differ only in quantitative characters: size of body, siphon, stigmal plate, gills, degree of branching of hairs, etc. The quantitative importance of these differences even in distinctly separated populations of the subspecies, is contiguous or transitional in their extreme variations. This becomes clear in the descriptions below.

Distribution. From the Atlantic to the Pacific and from 64°N (Finland) and Yakutsk to the southern boundary of the Palaearctic (North Africa, Iran), widely distributed in North America (only A. c. dorsalis).

192 Biology. Their most characteristic habitat are river valleys, where they often predominate among mosquitoes attacking man and animals. In mass flights, they enter inhabited areas, houses and cattle sheds. They breed in large numbers in floodplains after the floods. A new generation appears after the summer rain which is smaller than the spring generation.

(191)

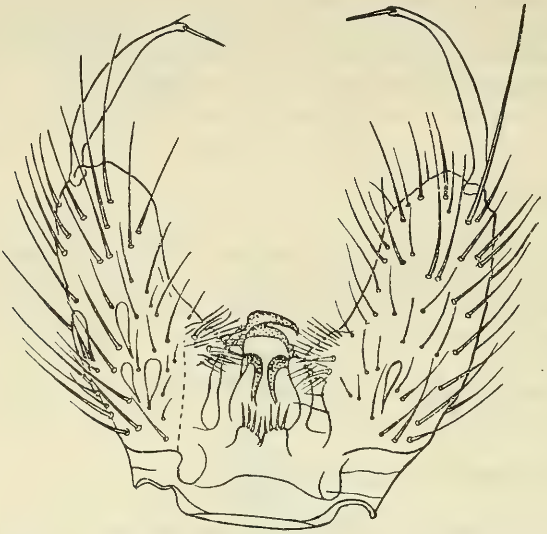

FIGURE 104. Hypopygium of Aedes caspius dorsalis Mg.

Note on systematics. Many authors consider A. c. caspius Pall. and A. c. dorsalis Mg. as different species. Their distribution overlaps in a large part. In Western and Central Europe the two forms are easily distinguished by the coloration of the adults, less by the structure of the hypopygium. Specimens with intermediate characters are rarely found. Further north, specimens become more common the subspecies of which is difficult or impossible to determine. Intermediate forms are also found in some parts of the European USSR (Volga area, Northern Caucasus), Kazakhstan and Siberia.

The characters of the Far Eastern A. caspius are mixed and intermediate. In Transbaikalia, the Maritime Territory and Northeast China specimens predominate, in which the mesonotum has two longitudinal, broad stripes of white or cream-colored scales with a narrow, dark, chestnut-colored or brown stripe between them. The lateral margins of the mesonotum are also covered with chestnut-colored scales. Deviations from this intermediate variation between A. c. caspius and A. c. dorsalis have been observed, e.g. instead of longitudinal, light stripes there may be light spots of irregular form, cream-colored scales may predominate and the dark scales form only a longitudinal stripe in the anterior part of the mesonotum. Specimens from the Maritime Territory are also intermediate in the structure of the hypopygium. They resemble A. c. dorsalis in the coloration of the wings. Southern populations (Kwangtung) resemble A. c. caspius more closely.

A. c. caspius occurs in Middle Asia but there are also intermediate forms. A. c. dorsalis inhabits mainly high mountain regions (Pamirs).

Although A. c. caspius and A. c. dorsalis (at least in the eastern part of their distribution) are connected by transitional characters, it seems justified to consider them as subspecies.

A detailed study of the geographical variation of A. caspius may make it possible to establish further subspecies, but some variations in coloration and other characters definitely depend on ecological factors, mainly on the conditions of development of the larvae. A description of new subspecies without a study of their ecology is therefore not justified.

Aedes duplex Mart. was described from two males from the Saratov Region (Martini, 1926, 1928). It resembles A. caspius but differs in the light color of the scales on the mesonotum, the weakly developed light rings on the tarsi, and the double number of spines on the basal lobe of the coxite. On each lobe are two straight spines situated close together and two curved spines, but similar characters of coloration are also often observed in A. caspius in different parts of its distribution. A double number of spines on the coxite is sometimes considered as an aberration. In the collections of the Zoological Institute there are males of A. caspius from Sarepta in the Volgograd Region with one, two or several additional spines in addition to the two spines on the basal lobe which are of nearly the same size and structure as the "normal" spines. There are transitions between the normal and aberrant specimens.

The status of A. duplex is thus doubtful in our opinion.

Aedes caspius caspius Pallas

In addition to the characters given in the key, we give the following. Proboscis and palps of male mainly with light scales. In the basal quarter of the costa there are dark scales among the light scales or the dark scales predominate. The dark spots on the abdominal tergites are brown, the light spots are yellowish or white in some places. The proximal spine of the basal lobe is sharply curved, with thin, hooked end.

193 The coloration of the mesonotum is very variable. The light longitudinal stripes may be narrow, distinct (the most common coloration) or wider and diffuse. They are sometimes yellowish and indistinct against the background of brown scales. The mesonotum is often also covered with yellowish brown or sand-colored scales. The size of the dark spots at the sides of the abdominal tergites varies to the complete absence of dark spots. B. N. Kazantsev (1931) found that the light, "sand-colored" A. caspius developed in Bukhara in water with a high salinity, while mosquitoes breeding in fresh water had a contrasting color. These color variants are characteristic not for the area but are found in different parts of the distribution of the subspecies.

Fourth-stage larva (Figure 105) medium-sized, yellowish, with lighter head and siphon. Frontal hairs slightly secondarily feathered,

outer hairs with 7–10 branches, median hairs situated before the inner hairs, both pairs simple, rarely 2-branched, very rarely one of the hairs
194 3-branched; postclypeal hairs with 3–5 short, thin branches. Antenna about half as long as the head, with sparse, small spines; hair tuft situated basal to the middle, with about 9 branches which are half as long as the antenna.

(193)

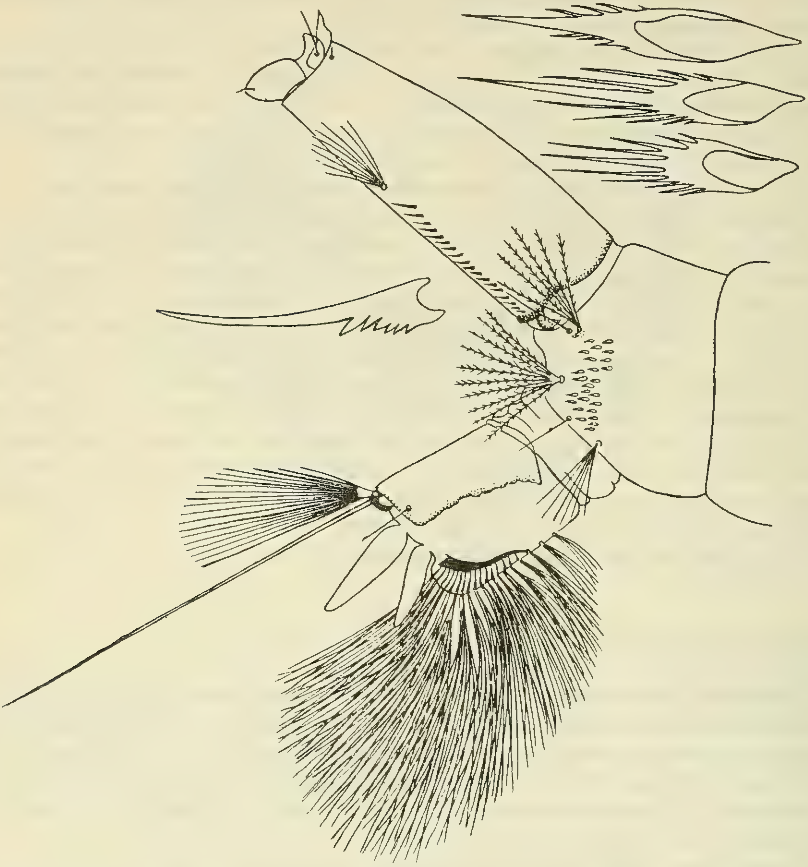

FIGURE 105. Aedes caspius caspius Pall. Fourth-stage larva. Posterior end, lateral.

Comb with 18–28 (usually 20–25) scales in 2–3 irregular rows. The scales vary markedly, from short scales without a main spine, with a row of small spines at the apex and margin, and narrower at the base to longer scales with one (or more) distinct spine and shorter scales at the base. Hairs behind the comb: dorsal hair with 5–10 branches, ventral hair with 6–7, median hair with 7–14 branches, intermediate hairs simple. Siphon straight, slightly tapering from the middle to the apex (index 1.8–2.6), of varying length. Pecten with 17–26 (usually 20–22) denticles, 1–4 denticles near the base rudimentary; denticles equally spaced; pecten slightly extending beyond middle of siphon. Hair tuft with 5–10 secondarily feathered, short branches, situated beyond middle of siphon. Stigmal plate typical for larvae of Ochlerotatus: 0.30–0.36 mm long, 0.27–0.32 mm wide at the posterior valves, 0.28–0.34 mm wide between the ends of the lateral valves.

Saddle extending to middle of sides of last segment; lateral hair simple, short, less than half as long as the saddle; outer caudal hairs simple, longer than the siphon, inner hair with 12–15 branches which are half as long. Fin with 14–17 tufts on the common base and 2–3 shorter tufts before it; 9–12 thin branches in each of the middle tufts. Gills short, 0.3–0.9 of length of saddle, leaf-shaped or lanceolate, lower pair shorter than the upper.

Distribution. The subspecies is characteristic for the steppe; it occurs in dry steppes with saline waters. It is distributed in Europe to England, southwest Finland, and the central parts of the European USSR. It also occurs in the southern regions of Siberia, Kazakhstan and Middle Asia. It is distributed in Mongolia, North and West China, West Asia and North Africa. In the steppes of the Ukraine, the Lower Volga area, east of Ciscaucasia and Transcaucasia, Kazakhstan and Middle Asia, A. c. caspius is the predominant species which attacks people and animals in masses, e.g., in the Mugan steppe (Zdrodovskii, 1926), in many parts of Turkmenia (Petrishcheva, 1936) and in the lower reaches of the Syr Darya (Blagoveshchenskii, 1937).

Biology. The larvae develop in open or shaded waters (south), permanent or temporary water bodies formed by the snowmelt, flooded rivers or overflows of irrigation, with little vegetation and with muddy bottom, often with a high concentration of salt (to 5% and higher). The eggs are deposited in moist soil at the edge of water bodies which do not dry up. There are several generations per year and they are sometimes very large (Middle Asia). The females bite man and animals, especially at dusk.

The species has a high resistance to heat and drought. In Tadzhikistan, activity is highest at temperatures of 19–31° (Bregetova, 1946). They often bite during the day. They may migrate for long distances, sometimes to 10 km.

195 They have a role in the spread of tularaemia and may be infected for a month (Olsuf'ev, 1938). They transmit Tahyňa virus in Czechoslovakia (Bárdoš and Danielová, 1959).

Aedes caspius dorsalis Meigen, 1830

The main characters are given in the key. Proboscis and palps of female mainly with dark scales. Costa with white scales in the basal quarter, without dark scales. Dark spots on the abdominal tergites blackish brown, light spots with a whitish gray tone. Proximal spine of basal lobe of coxite slightly curved, its apex usually not hook-shaped.

Fourth-stage larva (Figure 106) slightly larger than in A. c. caspius and darker, to brownish black. Frontal hairs secondarily feathered, outer hairs with 4–8 branches (usually 5–6), median hairs situated before the inner, both pairs simple, rarely 2-branched; postclypeal hairs short, with 2–5 thin branches. Antenna about half as long as the head, with sparse spines and a tuft with 4–7 branches in the middle, not more than half as long as the antenna.

Comb with 13–34 (usually 20–25) scales in 2–3 irregular rows; scales
196 very variable, as in A. c. caspius. Hairs behind the comb: dorsal hair with 3–8 (usually 4–5) branches, ventral hair with 4–6, median hair with 5–8 branches, intermediate hair simple. Siphon with an index of 2.5–3.0, rarely less. Pecten with 14–23 denticles, the first 4 denticles at the base rudimentary; pecten not reaching middle of siphon; denticles irregularly spaced, the distal denticles rarely slightly outside the row. Hair tuft with 3–8 (usually 4–5) secondarily feathered branches, situated in the middle of the siphon, branches not longer than the width of the siphon at the base. Stigmal plate (Figure 107) slightly larger and more darkly pigmented than in A. c. caspius.

(195)

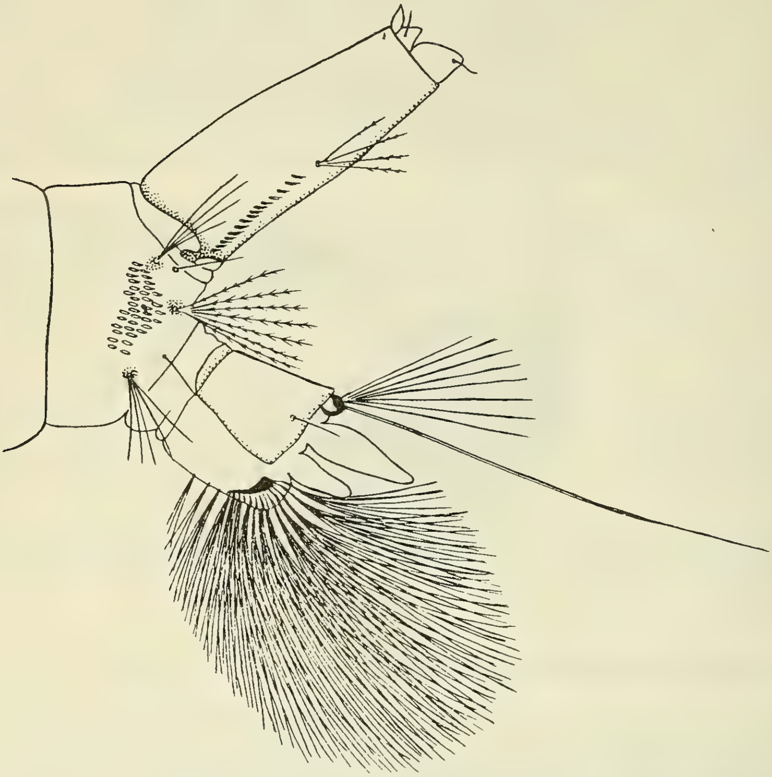

FIGURE 106. Aedes caspius dorsalis Mg. Fourth-stage larva. Posterior end, lateral.

Saddle as in A. c. caspius but more strongly pigmented and with sharply defined lower margin. Inner caudal hair with 4–12 (usually 8–9) branches, more than half as long as the outer hair. Number of tufts of the fin as in A. c. caspius, but each tuft is less branched, usually with 7–9 branches. Gills slightly longer than in A. c. caspius, about 1.3 times as long as the saddle in fresh water, not more than 0.3–0.4 of the length of the saddle in saline water.

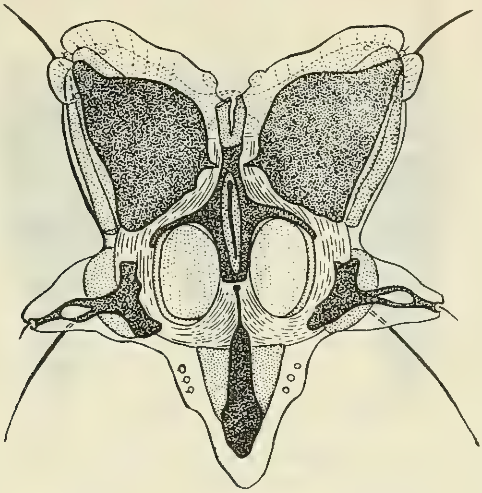

FIGURE 107. Aedes caspius dorsalis Mg. Fourth-stage larva. Stigmal plate.

Distribution. Characteristic for open habitats in mixed forests and forest-steppe. In the north it extends to the northern boundary of the distribution of the species, in the south to Hungary, Bulgaria, steppes in the Ukraine, Northern Caucasus, Lower Volga area and mountains of Middle Asia, including the Pamirs. Also Siberia, Far East (see above) and North America.

Biology. The larvae develop mainly in small, open water bodies and swamps. They are found in permanent or temporary water bodies formed by thawing snow, floods, rainfall or groundwater fresh or saline. The eggs hibernate. Several generations per year, especially during periodic floodings. They are very numerous in some localities. They are mass bloodsuckers in river valleys, e.g. the Volga and Dnieper. They bite at temperatures of 16–22° in the Moscow Region. The seasonal numerical curve has two peaks (Shlenova, 1959). There are 2–3 generations per year in the central European USSR (Khelevin, 1958).

They transmit western encephalitis (equine encephalomyelitis) in the U.S.A.

2. Aedes (Ochlerotatus) mariae Ed. and Et. Sergent, 1902

The species differs from A. caspius in the absence of a longitudinal light stripe on the abdomen and the absence of spines on the basal lobe of 197 the coxite. The description is based mainly on that of Senevet and Andarelli (1964), who noted great variation in the characters of this species.

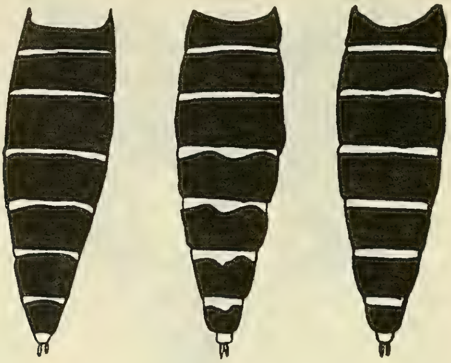

FIGURE 108. Abdomen of Aedes mariae Serg., dorsal (variation of coloration) (after Senevet and Andarelli)

Proboscis with reddish brown scales, sometimes mixed with whitish scales in the middle of the proboscis. Mesonotum with rust brown scales usually with a few whitish scales, which sometimes form an indistinct, narrow longitudinal stripe ("var. zamittii" Theob.). Tarsi with white rings, each ring extending to two segments; last segment of hind tarsi completely white. Wings with dark and light scales, more numerous on the costa, subcosta and r_1. Abdomen markedly varying in coloration (Figure 108). At the base of the tergites are narrow stripes of light scales which usually widen laterally into spots. A large part of each tergite is covered with dark scales; a longitudinal stripe of light scales is absent.

Hypopygium (Figure 109): apical lobe of coxite indistinct. The moderately convex basal lobe bears hairs and 4–5 larger setae. Claspettes with short, straight stem and narrow, curved wing, without transparent widening. Phallosome more or less rectangular. Lobes of tergite 9 with long setae (compared with those of A. caspius), 4–6 setae at each side.

Fourth-stage larva (Figure 110) of varying coloration. Frontal hairs: outer hairs usually with 7 branches, both inner pairs simple, a third as long as the outer, the median hairs situated before the inner hairs; postclypeal hairs very thin and short, branched. Antennae thin, slightly curved, with weak spines; hair tuft situated in the middle, with 6–9 branches, half as long as the antenna.

198 Comb with 16–25 scales in 2–3 rows; scales with distinct main spine with a varying number of denticles of different size at the base or with

1–2 denticles as large as the main spine. Siphon short (index 1.4–2.0), slightly tapering, with a varying degree of chitinization at the base; pecten reaching to middle of siphon, with 15 or more thin denticles which are longer distally and with accessory denticles in the basal third or half of the denticles; hair tuft with 6 branches, as long as the width of the siphon, situated slightly distal to the middle of the siphon.

(197)

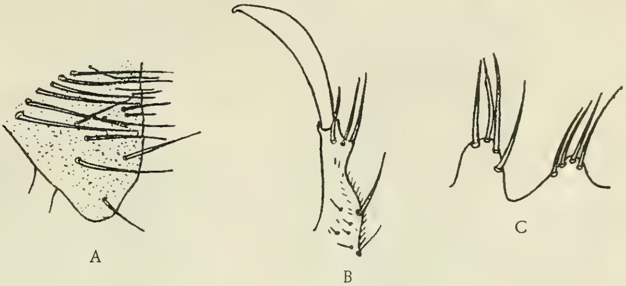

FIGURE 109. Hypopygium of Aedes mariae Serg. (after Senevet and Andarelli):

A — basal lobe; B — claspette; C — lobes of tergite 9.

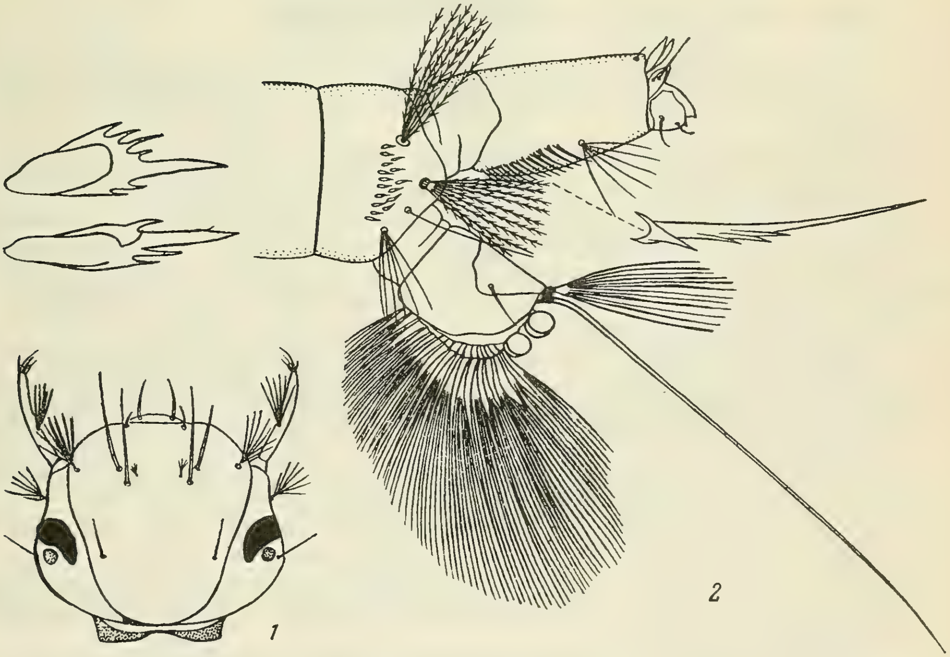

FIGURE 110. Aedes mariae Serg. Fourth-stage larva (after Edwards):

1 — head, dorsal; 2 — posterior end, lateral.

Saddle on last segment weakly developed, not completely covering the dorsal side and only extending slightly to the sides; lateral hair simple. Outer caudal hairs simple, long, inner hairs $\frac{1}{3}-\frac{1}{4}$ as long as the outer, with 11–14 branches. Fin strongly developed, with 12–13 tufts on the common base and 4–5 tufts before it. Gills short, spherical.

Distribution. Europe, Africa and Asia, mainly on the Mediterranean coast from Morocco to Syria. Not recorded with certainty from the USSR.

Biology. The larvae are found in rock pools on the sea shore, often in the surf zone. The usual concentration of salt in such pools is 2–4%, but the larvae tolerate a much higher concentration, to 18%.

The species transmits the parasite of bird malaria, Plasmodium relictum.

Note on systematics. The occurrence of A. mariae in the USSR is not certain. There is a record from the Ukraine (Prendel', 1966),
199 with the note that this needs confirmation. In the collections of the Zoological Institute is a preparation (possibly of A. mariae) which was found near Dnepropetrovsk in May 1928 by V. V. Goritskaya. The hypopygium resembles that of A. caspius, with the following differences: basal lobe of coxite, in addition to numerous hairs, with an irregular row of 7–8 more or less equal setae; spines or large setae absent; the weakly developed apical lobe bears a few hairs which are longer than those in A. caspius.

A. mariae possibly occurs in the south of the USSR but has not been differentiated from A. caspius.

3. Aedes (Ochlerotatus) pulchritarsis Rondani, 1872

The species is characterized by the absence of a light longitudinal stripe on the abdomen and the brown scales of the wings. It is divided into two subspecies.

Head with yellowish and brown scales. Palps of female brown, with white apex; palps of male brown, with white rings on the last segments. The coloration of the mesonotum differs in the two subspecies. Scutellum with yellowish scales. Pleurae of thorax with spots of white scales. Tarsi with contrasting white rings on the apex of the preceding and the base of the next seg-
200 ment. Last tarsal segment white. Wings with dark scales. Abdomen brown, with stripes of white scales at the base of the tergites.

Hypopygium (Figure 111): an apical lobe on the coxite absent; the weakly convex basal lobe has a long spine curved at the end and several slightly thinner setae; wings of claspettes narrow, long; lobes of tergite 9 slightly convex, with 4–6 short setae.

The white scales on the tarsi and abdomen of A. pulchritarsis give it some resemblance to species of the subgenus Stegomyia, but A. pulchritarsis has no lyre-shaped pattern on the mesonotum, which is characteristic for A. (Stegomyia) aegypti. In species of Stegomyia, the white rings on the tarsi are situated at the base of the segments while in A. pulchritarsis each ring extends to the apex of one segment and the base of the next.

Larvae semitransparent, milk white to grayish, with yellowish brown head and darker siphon.

(199)

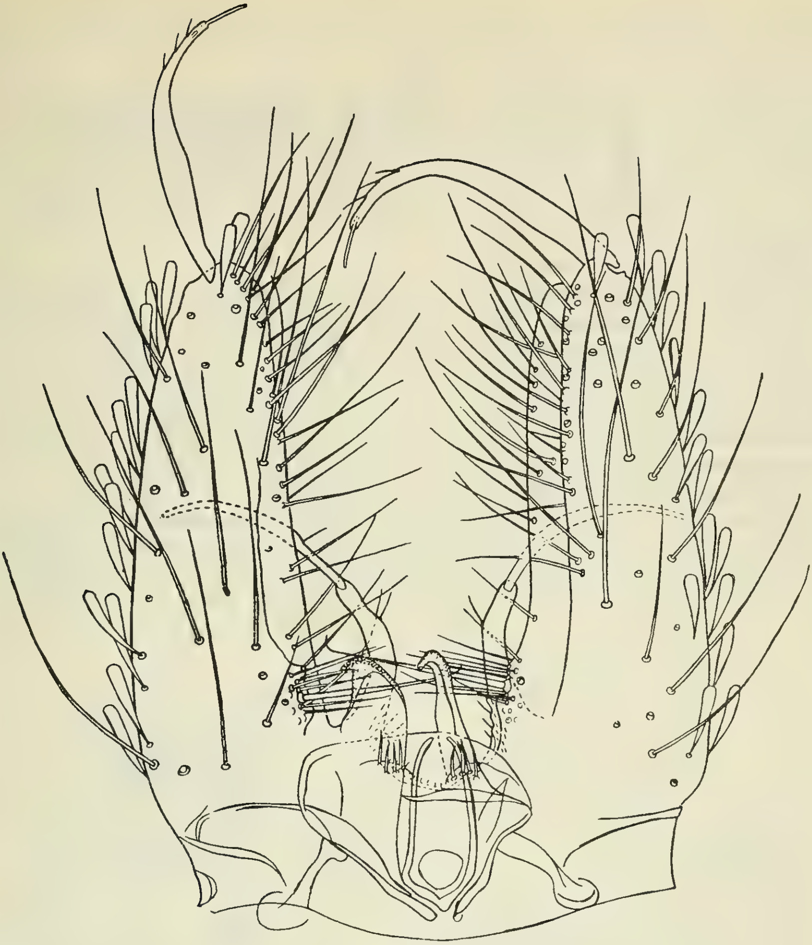

FIGURE 111. Hypopygium of Aedes pulchritarsis Rond.

The subspecies differ mainly in the coloration of the mesonotum and the length of the gills in the larvae.

Distribution. Mediterranean, South Asia. USSR: southern coast of the Crimea and other parts of the Ukraine, to Uzhgorod and Kharkov in the north, the Caucasus and Middle Asia.

Biology. It develops in tree holes. It occurs in humid forests and on irrigated farm lands. It is not an active bloodsucker.

Aedes pulchritarsis pulchritarsis Rondani

Mesonotum with golden scales and brown spots, the dark color sometimes predominating. Femora and tibiae dark anteriorly, with small spots of dark scales or with scattered light scales, often also completely dark anteriorly, with white apex. Tarsi with white rings.

Fourth-stage larva with nearly rounded head and broad anterior margin of the frontoclypeus. Size varying according to the size of the tree hole.

Frontal hairs situated near anterior margin of frontoclypeus, outer hairs with 6–13 (usually 10–12) branches, median hairs with 4–7 (usually 6–7), situated before the longer inner hairs, with 8–10 (rarely fewer) branches situated on one line with the outer hairs; postclypeal hairs with 11–18 branches, situated between the median and inner frontal hairs. Antennae thin, slightly curved, without spines; hair tuft with 1–4 (usually 2–3) thin, short branches, situated in the middle.

Comb on sides of 8th segment with 6–10 (usually 8) scales in one, sometimes irregular row; scales with a pointed terminal spine, with short, thin spines at the base. Siphon thin, straight, index 4–5; pecten with 17–24 closely spaced denticles; they are short, with a broad base and few spines; hair tuft situated in the middle, with 3–4 branches. Stigmal plate with a horseshoe-shaped posterior appendage to the "stirrup"; the formations on the lateral valves are more strongly connected by their base with the appendages of the "stirrup" than with the spiracles.

Last segment with a weakly developed saddle, which often covers the
201 segment only dorsally; lateral hair simple, long; outer caudal hairs simple, long; inner hairs with 3–5 branches, longer than the gills. Fin weakly developed, with 6–8 (rarely 9) slightly branched tufts (with 2–4, usually 3 branches), as long as the inner caudal hairs. Gills as long as the siphon, sausage-shaped, with rounded ends.

Distribution. Western part of the distribution of the species, in the Ukraine and Caucasus in the USSR.

Biology. The larvae develop in tree holes (maple, oak, elm, etc.), in tree stumps and among roots together with the larvae of A. geniculatus, A. plumbeus and O. pulchripalpis. They hibernate in the egg stage. The larvae hatch when the tree holes become filled with water. A few generations per year from March–April. The females are not active bloodsuckers.

Note on systematics. A. pulchritarsis var. berlandi Séguy, 1921 was first described as a variety, and later as a different species (Rioux and Arnold, 1955; Callot and Rioux, 1965). In A. berlandi, light spots on the femora and tibiae are absent or indistinct, the mesonotum is covered mainly with golden scales of different tones, sometimes with an indistinct longitudinal, white stripe; there are no differences in the structure of the hypopygium. A. berlandi is distributed in the Mediterranean, from Algeria to Iran, and often occurs together with "typical" A. pulchritarsis. We do not think that A. berlandi should be considered as a species as the differences are very variable. Specimens from the Crimea and Transcaucasia show variation in the coloration of the mesonotum and similar light spots on the femora and tibiae.

Aedes pulchritarsis asiaticus Edwards, 1926
(var. stegomyina Stackelberg and Montchadsky, 1926)

The subspecies differs mainly in the coloration of the mesonotum. Head with white and black scales which form spots. Mesonotum with blackish

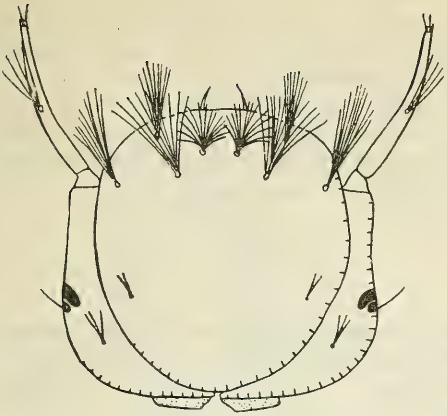

FIGURE 112. Aedes pulchritarsis asiaticus Edw. Fourth-stage larva. Head, dorsal.

brown or dark brown scales, with a longitudinal median stripe of white scales and white transverse stripes, stripes on the mesonotum sometimes formed by yellowish scales which are indistinct against the background; lateral margins of mesonotum with white scales. Rings on tarsi cream-colored.

The larva (Figures 112 and 113) differs from that of the nominate subspecies in the shorter siphon (index 3.0–3.3), fewer denticles in the pecten (16–18), gills twice as long as the siphon and nearly as thick, and fin with the same number of tufts but more weakly-branched, with at most 2 branches because of the stronger development of the gills.

Distribution. Eastern part of the distribution of the species. USSR: Middle Asia (Uzbekistan, Turkmenia, Tadzhikistan), to 2,100 m above sea level.

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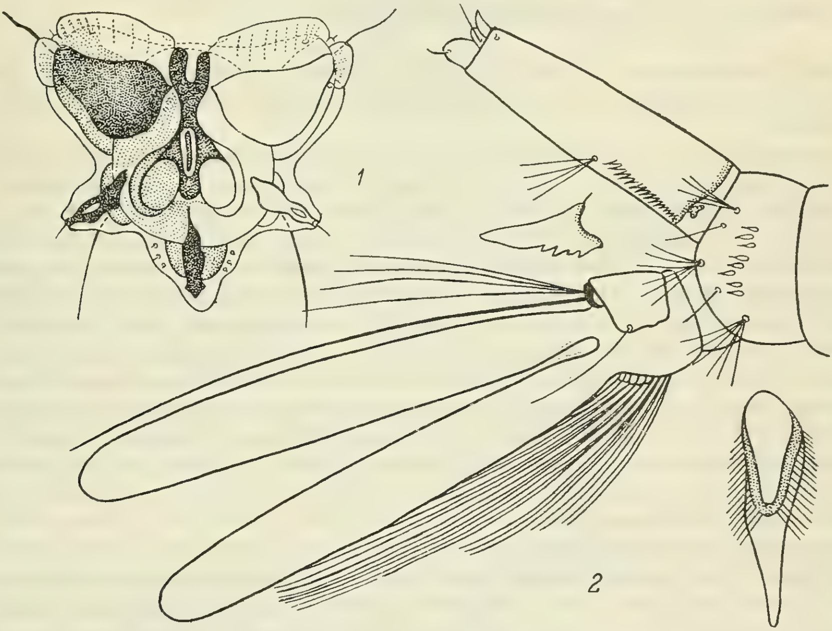

FIGURE 113. Aedes pulchritarsis asiaticus Edw. Fourth-stage larva:

1 – stigmal plate; 2 – posterior end, lateral.

Biology. The larvae breed only in water in tree holes (poplar, walnut, Phellodendron, elm, etc.), among roots flooded by water from irrigation and in tree trunks at a height of 0.5–2.0 m, from March to October. They hibernate and pass the dry period in the egg stage; the eggs are very resistant to drought. In Tadzhikistan it occurs together with A. plumbeus but mainly in tree holes with less alkaline and saline water. The females are not active bloodsuckers. Several generations per year.

cantans group

Tarsi with broad, light rings at base of segments (Figure 97,B). Large, rarely medium-sized mosquitoes. The hypopygium does not show characters present in all the species of the group. The larvae have 4–7 shorter tufts of the fin before the common base.

The species bite nearly always in the open, rarely entering houses.

Eight Palaearctic species belong to the cantans group which are characteristic for the forest zone of the Palaearctic and Nearctic; all of them occur in the USSR. Identification of the females is very difficult and not always certain. The boundaries of their geographical distribution need more exact definition.

4. Aedes (Ochlerotatus) cantans Meigen, 1818*

Large mosquitoes of dark coloration. Many contrasting white or yellowish scales among the dark scales on the proboscis, wings, femora and abdomen.

203 Head with yellowish white and brown scales, the brown scales usually forming two large spots. Palps of females dark, with scattered white scales and white apex; palps of males brown, with indistinct white rings at the base of the segments. Mesonotum markedly varying in coloration, with chocolate brown scales; lateral parts with whitish gray or cream-colored scales forming irregular spots or covering the parts nearly completely. Scutellum with white or yellowish scales. Pleurae with spots of white scales. Tarsi with white rings at the base of the segments; each ring occupies nearly half the length of the segment on the middle segments of the hind tarsi. Claws curved (Figure 102). Wings with dark scales, more or less mixed with light scales. Abdomen with weakly defined white or cream-colored stripes at the base of the tergites, stripes sometimes very narrow or nearly absent. More or less numerous light scales among the dark scales on the tergites.

Hypopygium (Figure 114) characteristic: basal lobe of coxite with one thick spine, lobe oblong, much higher than wide; wing of claspettes broad.

Fourth-stage larva (Figure 115) large, brown, with paler head and 204 siphon. Frontal hairs: outer hairs with 6–11 (usually 7–8) branches, median hairs with 2–3 (usually 2) branches, situated before the inner hairs with 3–4 branches; postclypeal hairs with 2 (rarely 3) short, thin branches, situated between the median hairs. Antenna half as long as the head or longer, slightly curved, with distinct spines and a short tuft with 6–9 branches.

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* Many authors name this species A. maculatus Meigen, 1804, but this name is a synonym of A. rusticus Rossi, 1790.

(203)

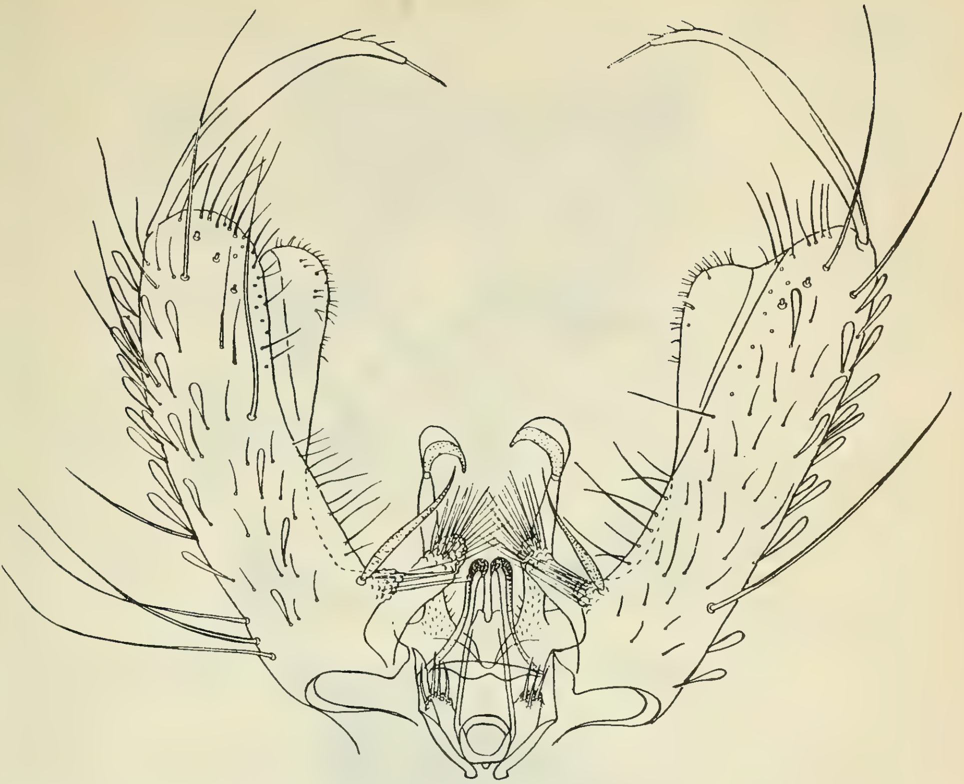

FIGURE 114. Hypopygium of Aedes cantans Mg.

Comb on 8th abdominal segment with 28–40 (usually 35–36) scales in 2–4 irregular rows, each scale with a pointed main spine and with small spines at the sides of the base, 1–2 spines sometimes distinctly larger. Siphon straight, tapering from $^2/_5$ from the base (index 3.0 or slightly less); pecten with 21–33 (average 26–27) denticles, not reaching middle of siphon; hair tuft situated in the middle, with 5–7 branches, not longer than the width of the siphon at the base. Stigmal plate (Figure 116) with characteristic structure of the posterior appendage of the "stirrup": between the lateral
205 branches is a variously developed (often weak) median branch in the form of an oblong leaf, and the anterior valve is much longer than in the other species.

Saddle of last segment reaching to middle of sides; lateral hair long, simple; outer caudal hairs long and simple, inner hairs with 7–9 branches half as long as the outer hairs. Fin with 18–19 tufts on the common base and with 4 (rarely 5) shorter tufts before it. Gills of varying length, rarely as long as the saddle, usually 1.5 times as long.

Distribution. Western Europe to the Far East. It is very common in the western parts of its distribution area but rare in the east. Characteristic for mixed forests and also enters the taiga. Records from the forest-tundra and tundra probably refer to other species. It extends to the

Northern Caucasus, Crimea and Southern Europe (Italy and Spain) in the south.

(204)

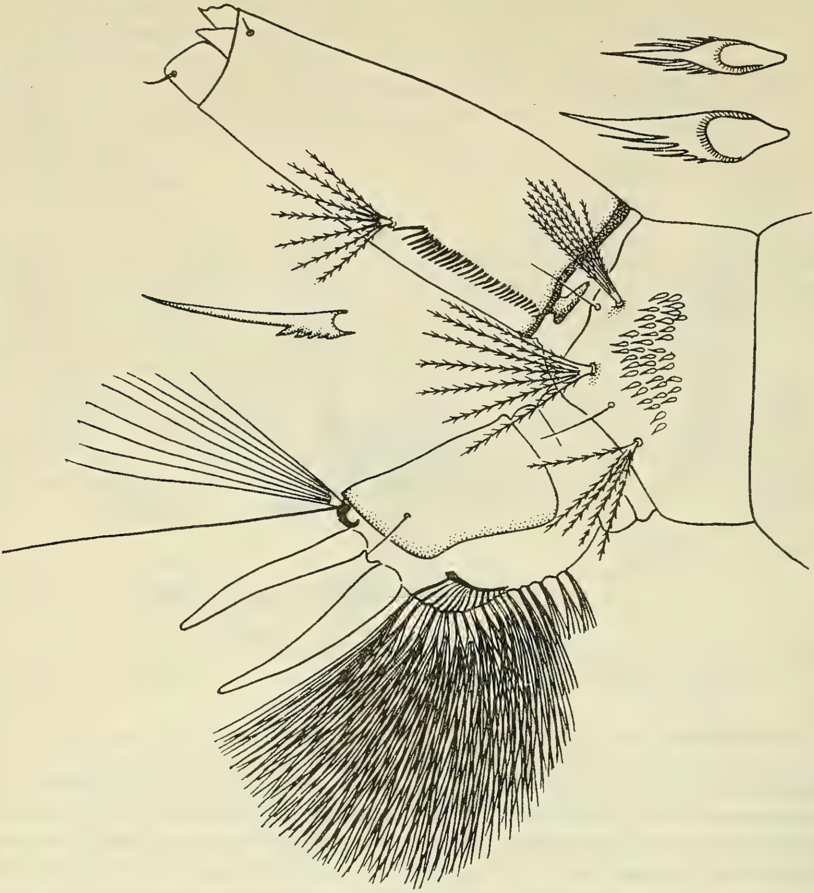

FIGURE 115. Aedes cantans Mg. Fourth-stage larva. Posterior end, lateral.

Biology. The larvae develop in the spring in puddles, pits and ditches with numerous fallen leaves, without vegetation or with poor vegetation on the edge of forests or in thinned parts of forests, often together with A. communis and A. punctor. A mid-spring species which appears later than the preceding species and has one generation per year. There is sometimes a second generation after the summer rains but this is small. They hibernate in the egg stage; the eggs are deposited on moist soil near the water. It is one of the most widespread mass bloodsuckers which bite man and animals. In many parts of the forest belt of the European USSR it is one of the most numerous species. It bites almost exclusively in the open.

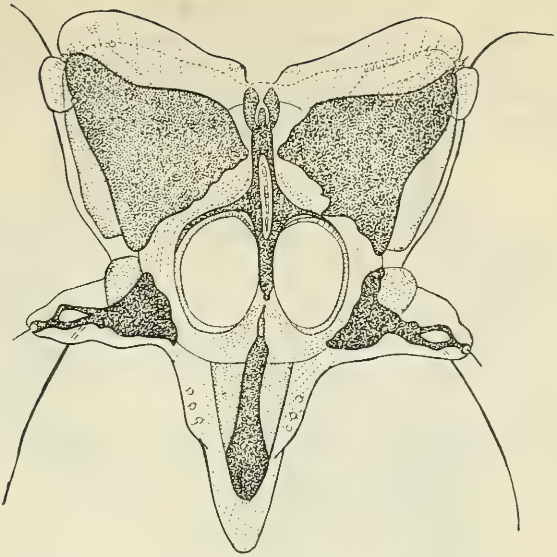

FIGURE 116. Aedes cantans Mg. Fourth-stage larva. Stigmal plate.

5. Aedes (Ochlerotatus) riparius Dyar and Knab, 1907 (semicantans Martini, 1920)

It is closely related to A. cantans, but differs distinctly in males and larvae. Medium-sized, rarely large.

Mesonotum usually with a distinct longitudinal stripe of dark brown or bronze scales, lateral parts with lighter golden or cream-colored scales, sometimes with narrow, bronze stripes, of the same color as the broad median stripe.

Anterior side of hind femora often light. Claws slightly curved. White stripes at base of abdominal tergites relatively broad and distinct; there are sometimes narrow, light stripes at the apex of the tergites.

206 The coloration is very variable. The North American populations have no dark stripe on the mesonotum. Because of the variation, the females cannot always be determined with certainty. The structure of the hypopygium gives more reliable characters (Figure 117). The basal lobe of the coxite is shorter than in A. cantans, about as high as wide at the base; wing of claspette narrower.

Fourth-stage larva (Figure 118) medium-sized, dark. Frontal hairs secondarily feathered, outer hairs with 4–9 (average 5–6) branches, the median hairs situated before the inner hairs, both pairs with 2 (rarely 3) branches; postclypeal hairs situated between the median hairs, thin, short, with 3–4 branches. Antenna slightly longer than the head, nearly straight, with distinct spines and a tuft with 3–5 branches in the middle.

Comb of 8th abdominal segment with 6–9 large scales in an irregular row, scales with a strongly developed, pointed main spine and smaller spines near the base. Siphon straight, slightly tapering from the basal third, index 3.5–4.0; pecten with 14–21 (average 16) thin denticles occupying slightly more than $^1/_3$ of the siphon, 2–3 distal denticles more widely spaced; tuft situated in the middle, slightly basal to it, with 3–5 branches, with slight secondary feathering, about $^1/_3$ as long as the siphon.

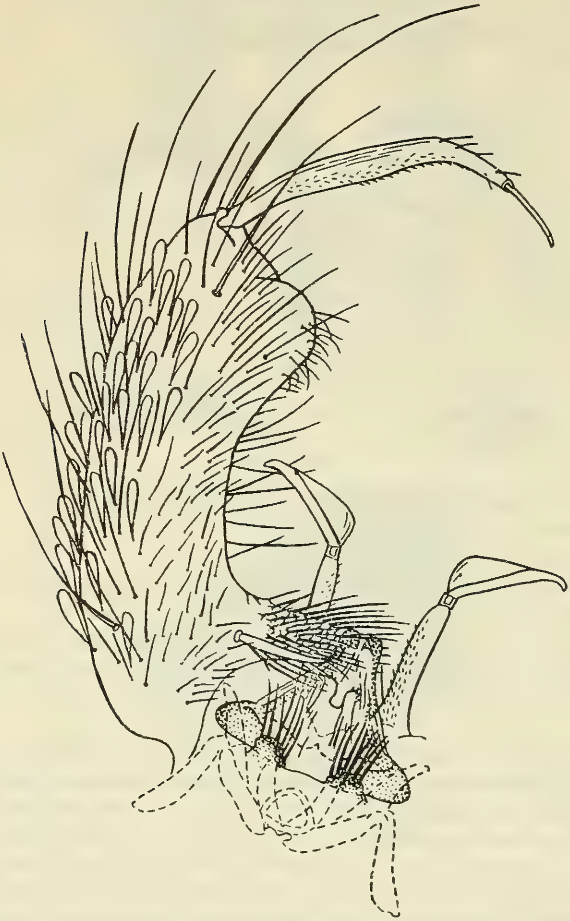

FIGURE 117. Hypopygium of Aedes riparius riparius D.K. (after Carpenter and La Casse)

Saddle of last segment covering $^4/_5$ of the sides or more; lateral hair simple, nearly as long as the saddle; outer caudal hairs simple, longer than the siphon, inner hairs forming a fan with 5–8 branches, half as long as the outer hairs. Fin with 15–18 tufts on the common base and 4–6 shorter tufts before it. Gills to 1.5 times as long as the saddle, thin, pigmented, with pointed ends.

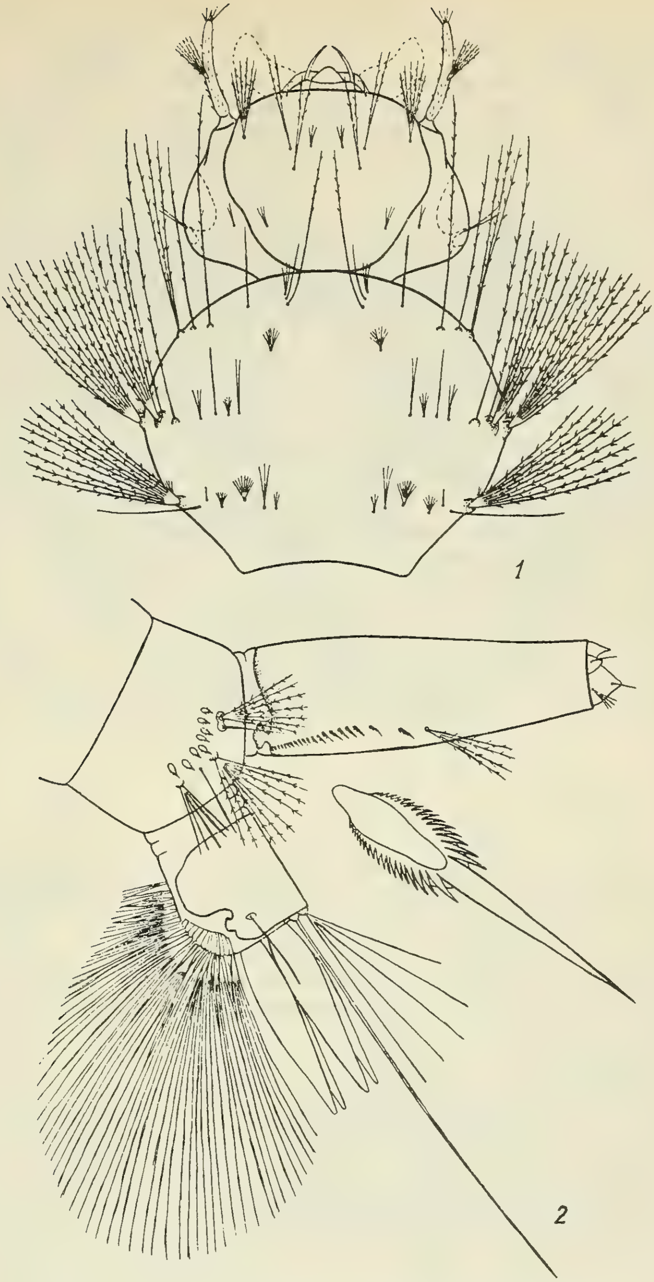

FIGURE 118. Aedes riparius D.K. Fourth-stage larva (after Carpenter and La Casse):

1 – anterior end, dorsal; 2 – posterior end, lateral.

The differences between the larvae of the two subspecies of A. riparius have not been determined.

208 Distribution. Forests of Europe and North Asia, North America. It extends to the boundary of the forest zone in the north and also apparently occurs in the tundra. It enters the forest-steppe in the south. The boundaries of its distribution have not been exactly determined. This is a relatively rare species.

Biology. The larvae breed in ponds in spring in open landscapes, mainly in peat bogs with a bottom of Sphagnum, together with A. punctor. They hibernate in the egg stage. Usually one generation per year. The females are active bloodsuckers but do not occur in large numbers.

Aedes riparius riparius Dyar and Knab

Proboscis dark, with an admixture of light scales which form an indistinct ring in the middle. Palps of female with dark scales and a few light scales. Last segment of hind tarsi with a white ring at the base. Wings with dark and light scales. Second abdominal tergite without a longitudinal light stripe or with an indistinct stripe not extending on the whole tergite.

Hypopygium (Figure 117) resembling that of A. cantans; stem of claspette straight, wing with a short manubrium, plate-shaped widening distinct in the middle or near the base.

Europe, Siberia. The North American form is apparently more closely related to the European form.

Aedes riparius ater Gutsevich, 1955

Proboscis, palps of female and wings with brown scales; slightly lighter scales may be present at the base of the costa. Last segment of hind tarsi without a white ring. Second abdominal tergite with a distinct longitudinal white stripe extending to the posterior margin.

Hypopygium (Figure 119) different from that of A. cantans; stem of claspette curved, wing with long manubrium, plate-shaped widening present only in the distal half, sometimes only in the distal third of the wing.

Larvae unknown.

Distribution. Maritime Territory, Khabarovsk Territory, Siberia, northeastern part of the European USSR.

Note on systematics. There are distinct differences in coloration and especially in the structure of the hypopygium between the two forms (subspecies?). A. r. ater should possibly be considered as a different species closely related to the North American A. squamiger Coquillett, 1902.

6. Aedes (Ochlerotatus) behningi Martini, 1926

Smaller than the other species of the cantans group, mainly dark.

(209)

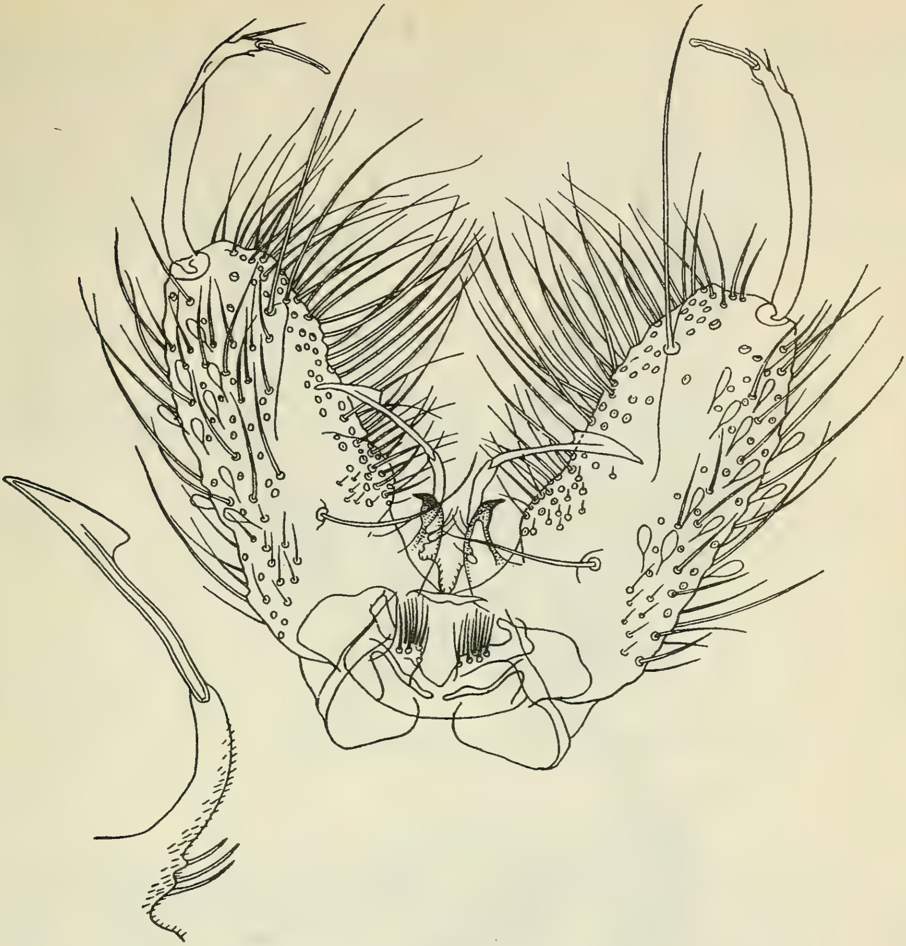

FIGURE 119. Hypopygium and claspette of *Aedes riparius ater* Guts.

Proboscis and palps brown, with a small admixture of light scales.
Mesonotum with narrow, bronze or rust-colored scales, sometimes (often
in males) with an indistinct dark brown longitudinal stripe. Mesonotum
blackish brown. Tarsi with light rings on the middle segments of the hind
tarsi about half as long as the segment or shorter. Wings with brown
209 scales and a few light scales. Abdomen with brown and light scales, usually
forming indistinct spots in the midline, one spot sometimes extending to two
tergites. Distinct, light stripes absent. In males, light scales are usually
scattered irregularly on the tergites without forming spots.

Exact determination of the females is not always possible. The hypopygium (Figure 120) differs distinctly from that of the other species. The conical basal lobe of the coxite is without spines and large setae. The basal lobe bears a spine in the other species of the cantans group, but if a spine is absent the lobe is flat and indistinct.

(210)

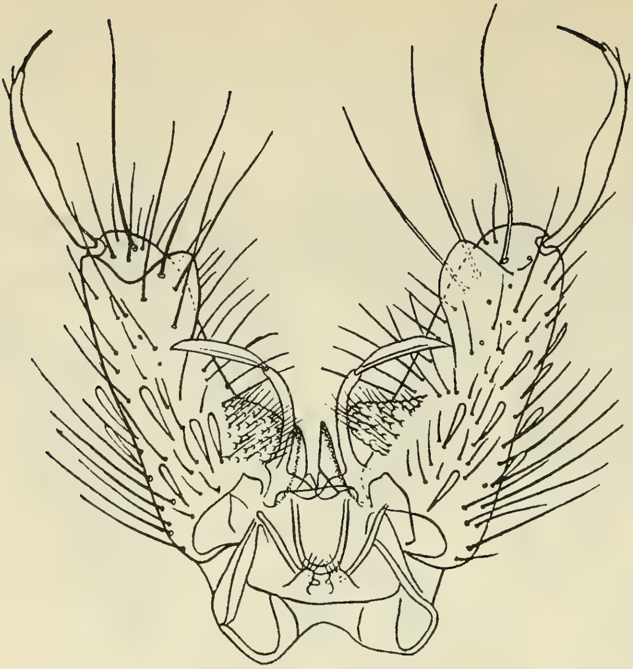

FIGURE 120. Hypopygium of *Aedes behningi* Mart.

Fourth-stage larva (Figure 121) closely resembling that of
A. excrucians and often practically indistinguishable from it. Frontal
hairs coarse, secondarily feathered, outer hairs with 6–8 branches, median
210 hairs situated before the inner hairs, with 2–3 branches; inner hairs with
2–4 (usually 2) branches; postclypeal hairs with 6–8 thin, short branches.
Antenna about half as long as the head, with distinct spines and a hair tuft
with 8–9 branches in the middle.

Comb with 20–28 (usually 24) scales in 2–3 irregular rows; scales with well developed pointed main spine and several spines at the sides of the base. Siphon tapering apically but less strongly than in *A. excrucians* (index 3.0–4.0, average 3.5); pecten with 18–28 (usually 22–24) denticles, 1–3 denticles larger and more widely spaced; however, the distance between them is quite often not greater than between the adjacent denticles; tuft with 5 branches, less than half as long as the siphon, situated in the middle, slightly distal to it. Hairs on posterior valves of stigmal plate curved like a hook but slightly thinner than in *A. excrucians*. The stigmal plate has not been described.

Saddle reaching nearly to the lower margin of the segment; lateral hair simple, as long as the saddle; outer caudal hairs simple, as long as the siphon, inner hairs forming a fan with 14—17 branches. Fin with 14—17 tufts on the common base and 5—6 shorter tufts before it. Gills as long as the saddle or slightly longer, not pigmented.

Distribution. USSR and Siberia, to Krasnoyarsk and Barnaul in the east, to the southern boundary of the taiga in the north, to the Ukrainian steppe in the south. The species also occurs in Czechoslovakia (Trpiš, 1965b); the distribution in the west has not been determined.

Biology. The larvae are found in large numbers in floodplains of rivers. One generation per year in the spring.

211 7. Aedes (Ochlerotatus) excrucians Walker, 1856

It differs from the three preceding species in its lighter color and the structure of the hypopygium. Markedly varying in coloration.

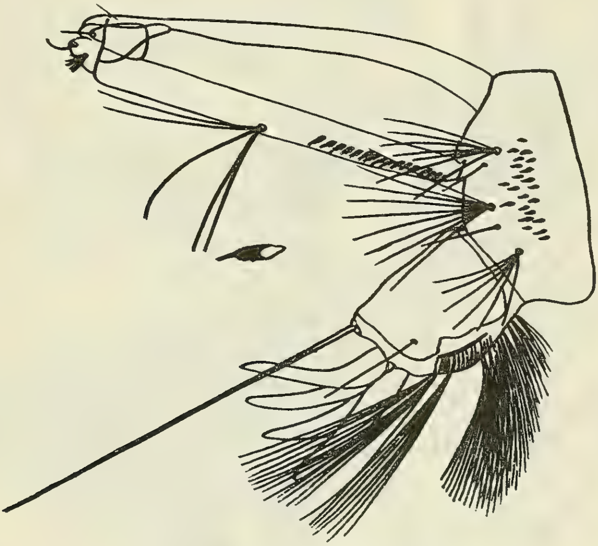

FIGURE 121. Aedes behningi Mart. Fourth-stage larva. Posterior end, lateral (after Martini).

Proboscis and palps with brown and yellowish brown scales. Mesonotum with rust yellow or reddish brown scales, scales at sides usually lighter, sometimes with an indistinct broad longitudinal stripe of darker scales. Integument of mesonotum brown, rarely blackish brown in the middle, brown laterally. Scales on pleurae of thorax yellowish. Anterior side of fore femora variegated. Tarsi with light rings which are about half as long as the segment on the middle segments of the hind tarsi. Claws large, sharply curved; the large denticle nearly parallel to the claw (Figure 122). There are specimens with a less developed denticle directed toward the claw. Wings with dark brown and yellowish white scales, dark scales usually predominating. Abdomen with brown and yellowish white scales which usually form indistinct stripes at the base and sometimes also at the apex of the tergites. Tergites often completely variegated. The coloration of the abdomen is very variable. For example, in some of the specimens from Transbaikalia and the Far East, there are few or no dark scales on the abdomen, and light scales predominate on the wings. These specimens resemble A. cyprius and A. flavescens.

(212)

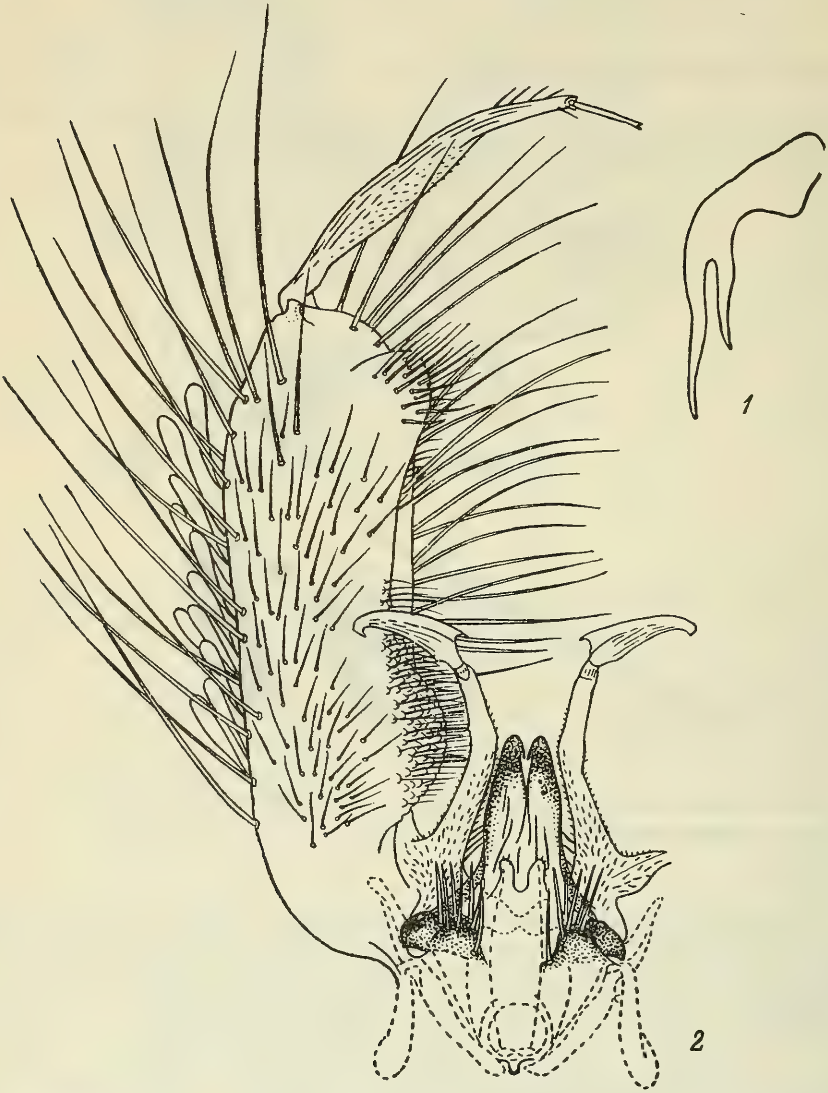

FIGURE 122. Hypopygium of Aedes excrucians Walk. (after Carpenter and La Casse): 1 – claw; 2 – hypopygium.

Hypopygium (Figure 122): basal lobe low, densely covered with short hairs, without large setae or spines; stem of claspette long, slightly curved, slightly tapering apically; wings of claspette 3 times longer than their widest part.

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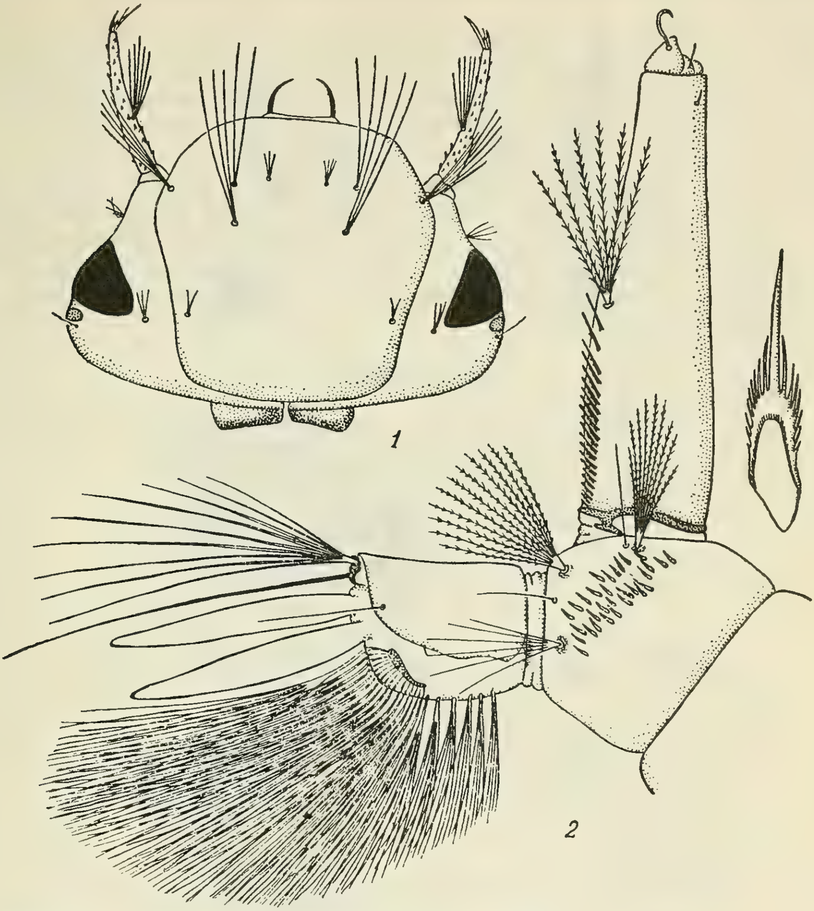

FIGURE 123. Aedes excrucians Walk. Fourth-stage larva:

1 – head, dorsal; 2 – posterior end, lateral.

Fourth-stage larva (Figure 123) large, yellowish brown. Frontal hairs with varying secondary feathering: outer hairs with 4–9 (usually 7–8) branches, median hairs with 1–3 (usually 2), inner hairs situated behind the median hairs, with 2–6 (usually 2–3) branches; postclypeal hairs with 2–3 thin, short branches. Antenna about half as long as the head, covered with spines, hair tuft with 3–8 (usually 7–8) secondarily feathered hairs half as long as the antenna, situated in the middle, slightly basal to it.

Comb of 8th abdominal segment with 30–40 (usually 32–36) scales. The number of scales varies markedly, there may be about 20 or rarely even fewer scales. The larvae cannot be determined by this character. Each
213 scale has a distinct, long main spine and smaller, thinner spines at the

sides of the base. Siphon straight, tapering distinctly from $^2/_5$ from the base (index 3.2 to 4.4, sometimes 5); pecten with 16–27 spinelike denticles which are longer distally, 1–3 distal denticles more widely separated and larger; tuft situated distal to the middle, with 5–6 broadly divergent, secondarily feathered branches.

Stigmal plate (Figure 124) characteristic; it differs from that of related species in that the distance between the apex of the posterior valves is much greater than the length of the plate, in the hook-shaped, thick hairs at the apex of the posterior valves and in the narrow, dark, chitinized anterior valve, which is slightly wider apically.

Saddle extending beyond middle of sides of last segment; lateral hair simple, as long as the saddle; outer caudal hairs very long, longer than the siphon, inner hairs forming a fan with 7–9 branches, half as long as the 214 outer hairs. Fin with 16–20 tufts on the common base and of 4–6 shorter tufts before it. Gills long, not longer than the saddle, but sometimes as long as the siphon, not pigmented.

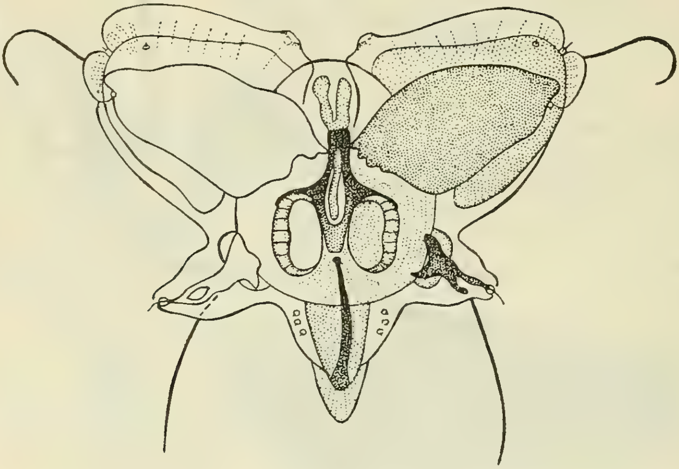

FIGURE 124. Aedes excrucians Walk. Fourth-stage larva. Stigmal plate.

Distribution. Europe, Kazakhstan, Siberia, Far East of the USSR, Mongolia, Northwest China, Japan, North America. It extends to the tundra in the north and sometimes enters the tundra, particularly in river floodplains (north of Norway, to 70°). To the Crimea, Caucasus and mountains of Asia Minor in the south. It is distributed throughout the zone of the forest and forest-steppe, and sometimes occurs in large numbers.

Biology. The larvae breed in temporary water bodies in spring, rarely in permanent water bodies with vegetation, in open pools in meadows and floodplains, at the edge of forests, in thinned out forests, sometimes in slightly saline water at the sea shore. There is normally one generation in spring from hibernating eggs. Flight begins a week to ten days after the first appearance of Aedes. The larvae descend to the bottom if disturbed and often remain there for a long time. Stirring brings them to the surface. The females are mass bloodsuckers. Flight continues for a long time, sometimes also in summer.

The species transmits tularemia. Natural infections have been found.

(215)

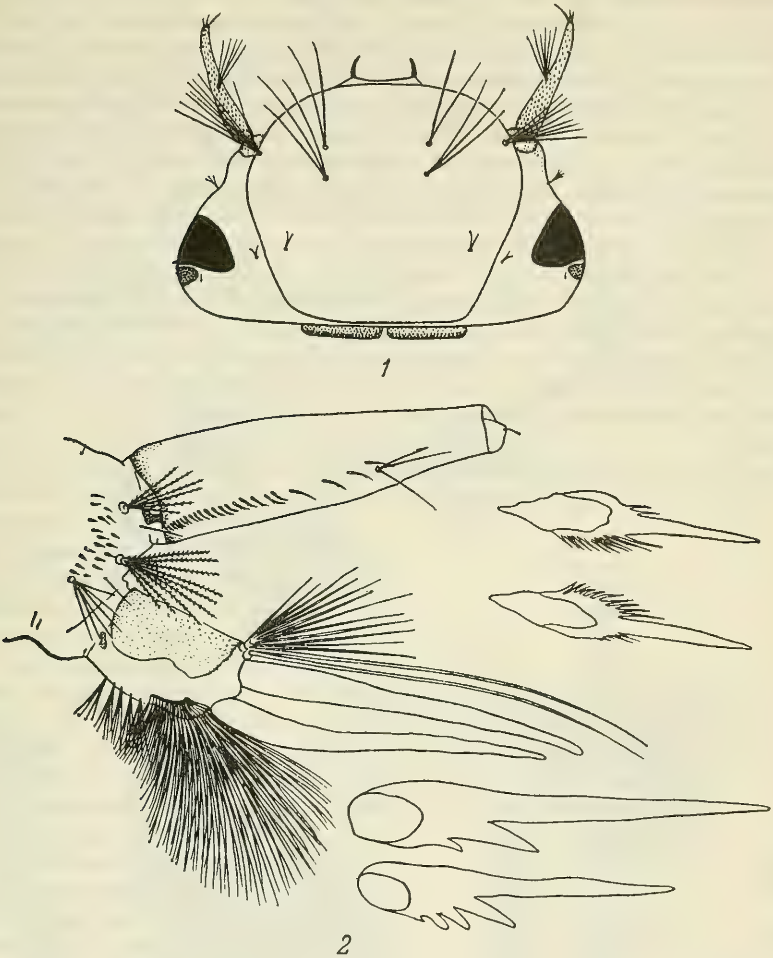

FIGURE 125. Aedes beklemishevi Den. Fourth-stage larva (after O.N.Sazonova):
1 — head, dorsal; 2 — posterior end, lateral.

8. Aedes (Ochlerotatus) beklemishevi Denisova, 1955 (grandilarva Sazonova, 1956)

Closely related to A. excrucians. Determination is possible only by the larvae.

Mesonotum with golden or bronze scales. Fore femora light anteriorly,
with a few dark scales. Claws (Figure 102, 20) large, with sharply diverging
denticle (Sazonova, 1958). Wings mainly with dark scales mixed with yellow
scales. Anterior tergites with distinct light stripes at the base, usually
215 with narrow stripes at the apex of the tergites. There are no differences
from A. excrucians in the hypopygium.

Fourth-stage larva (Figure 125) very large, usually more than 1 cm long, dark. Frontal hairs secondarily feathered, coarse, outer hairs with 5–9 (usually 7–8) branches, median hairs with 1–3 (2 in 90%), situated before the inner hairs with 2–4 (usually 3) branches; postclypeal hairs thin, short, situated between the median hairs, with 2–7 (usually 3–6) branches. Antenna short, less than half as long as the head, slightly curved and with small spines, and with a tuft with 2–7 (usually 3–5) branches in the middle.

Comb on 8th abdominal segment with 14–20 (usually 16–18) scales in
2–3 irregular rows, with a long pointed main spine and small, thin spines
216 laterally at the base. Siphon long, straight, distinctly tapering in the apical
third (index 3.1–3.5); pecten with 16–28 (usually 22–26) denticles, 2–5
rudimentary denticles at the base and 2–6 (usually 3–4) distal denticles
which are larger and widely separated, the distal denticle in the apical
third of the siphon. Near it is the tuft with 2–4 (usually 3) thin, slightly
secondarily feathered branches, not longer than the width of the siphon at
the base.

Hairs at apex of posterior valves of stigmal plate not hook-shaped and thick as in A. excrucians, but as usual for larvae of Ochlerotatus.

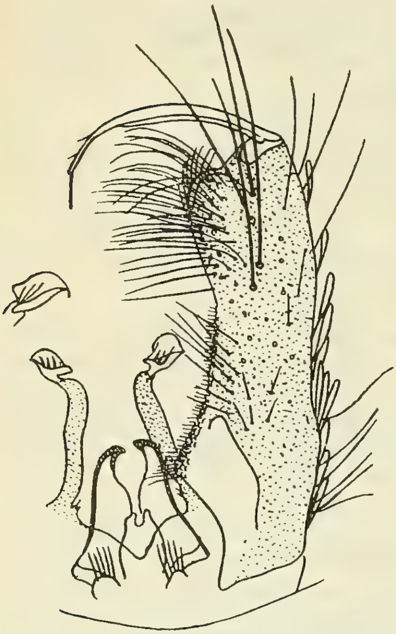

FIGURE 126. Hypopygium of Aedes annulipes Mg. (after Martini)

Saddle of last segment extending to nearly $^3/_4$ of the sides; lateral hair simple, about $^2/_5$ as long as the saddle. Outer caudal hairs simple, slightly longer than the siphon, inner hairs forming a fan with 11–16 (usually 14–16) hairs which are half as long as the outer hairs. Fin with 17–22 (usually 19–20) tufts on the common base and 4–7 shorter tufts before it. Gills long, nearly as long as the siphon, slightly pigmented.

Distribution. Described from the Kursk, Yaroslavl and Moscow regions (Denisova, 1955). Recorded from many localities in the European USSR and Siberia, to the Sea of Okhotsk in the north. Boundaries of distribution not known. It often occurs together with A. excrucians but is usually less numerous.

Biology. The larvae develop in temporary, open water bodies on meadows, felled areas, rarely in forests. One generation in late spring, but sometimes also in autum if there is rain. Hibernation in the egg stage. Widely distributed, but not numerous. The females are active bloodsuckers and bite during the day and at night.

9. Aedes (Ochlerotatus) annulipes Meigen, 1830 (quartus Martini, 1920)

Closely related to the preceding species, but differs in the coloration of thorax and abdomen. There is a small difference in the structure of the hypopygium. Because of the large variation of coloration, this character is not reliable for determination.

Mesonotum with a broad, dark longitudinal stripe of chocolate brown scales, lateral parts with cream-colored or grayish scales. Abdomen with distinct yellowish stripes at the base of the tergites; light scales may also be present at the apex of the tergites.

Hypopygium (Figure 126) mainly as in A. excrucians, but stem of claspette relatively thick, not tapering apically, sometimes even thicker apically than at the base.

(217)

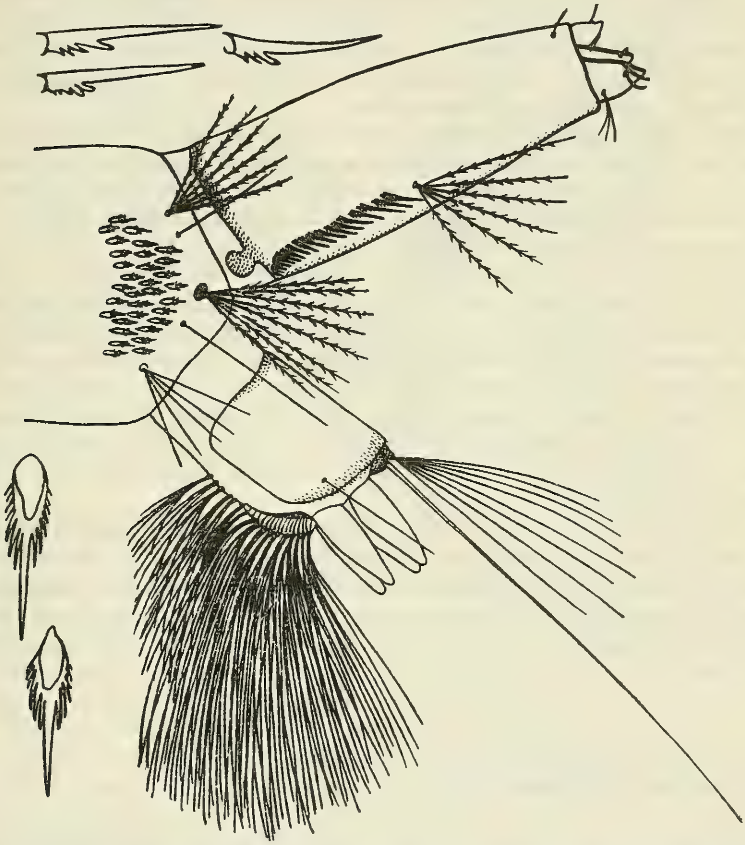

FIGURE 127. Aedes annulipes Mg. Fourth-stage larva. Posterior end, lateral (after Marshall).

Fourth-stage larva (Figure 127) resembling that of A. cantans. Some larvae of cantans differing slightly from typical larvae have been identified as A. annulipes.

217 Outer frontal hairs usually with 7 branches, median hairs situated before the inner hairs, the median hairs with 1–4 (usually 2), inner hairs with 3–6 (usually 4) coarse, secondarily feathered branches; postclypeal hairs situated between the median hairs, short, thin, with 2–3 branches. Antenna slightly curved, darker apically, with distinct spines and a tuft with 4–7 branches in the middle.

Comb on 8th abdominal segment with 29–45 (usually 33–34) scales in 2–4 irregular rows, scales with a pointed main spine and a row of spines at the sides of the base. One or two spines near the base may be larger but not as large as the main spine. Siphon moderately tapering from the middle (index 3.0 to 3.5). Pecten with 17–26 (usually 21–23) densely situated denticles and 1–4 rudimentary denticles at the base, extending to $^2/_5$ of the siphon from the base. Tuft with 3–7 (usually 5) branches, situated in the middle, slightly secondarily feathered, longer than the width of the siphon at its position. Stigmal plate with bifurcate posterior appendage of the "stirrup," as usual in the subgenus.

Saddle of last segment extending beyond the middle of the sides; lateral 218 hair simple; outer caudal hairs simple, slightly longer than the siphon, inner hairs half as long, usually with 8 branches. Fin usually with 16 tufts on the common base and 4–5 shorter tufts before it. Gills usually slightly shorter than the saddle, lanceolate.

Distribution. West and Central Europe, from southern Sweden to Yugoslavia. In some parts of Poland and Czechoslovakia the species appears in large numbers (Skierska, 1963; Dabrowska-Prot, 1964; Trpiš, 1965a). There are many records from the European and Asian USSR, mainly from the forest zone. Most of these records probably refer to other species of the cantans group. Without males, identification by females is not reliable. This was noted also by Sazonova (1958). A. annulipes is probably distributed only in the European USSR: Estonia (Remm, 1957), the Ukraine (Val'kh, 1959).

Biology. The larvae are found in open ponds in spring or in water bodies partly shaded by shrubs. In the plains, they occur on meadows at the edge of forests, often together with A. cantans but in smaller numbers. A mid-spring species with one generation. Hibernation in the egg stage. Behavior of the larvae as in A. excrucians. The females are active bloodsuckers.

10. Aedes (Ochlerotatus) flavescens Müller, 1764 (lutescens Fabricius, 1775)

Large, rust brown mosquitoes of mainly dark coloration, differing from the preceding species in the light abdomen and structure of the hypopygium.

219 Proboscis and palps of female with brown and yellowish brown scales. Palps of male with light scales forming a broad ring. Mesonotum with small, dark rust brown or reddish brown scales. Pleurae of thorax with grayish white scales covering the entire dorsal mesepisterna. Lower

mesepimeral setae absent. Legs with light rings about half (or slightly more) as long as the segment on the middle segments of the hind tarsi.
220 Wings with brown and yellowish white scales. Abdomen dorsally with yellowish gray scales, sometimes with a few dark scales.

(218)

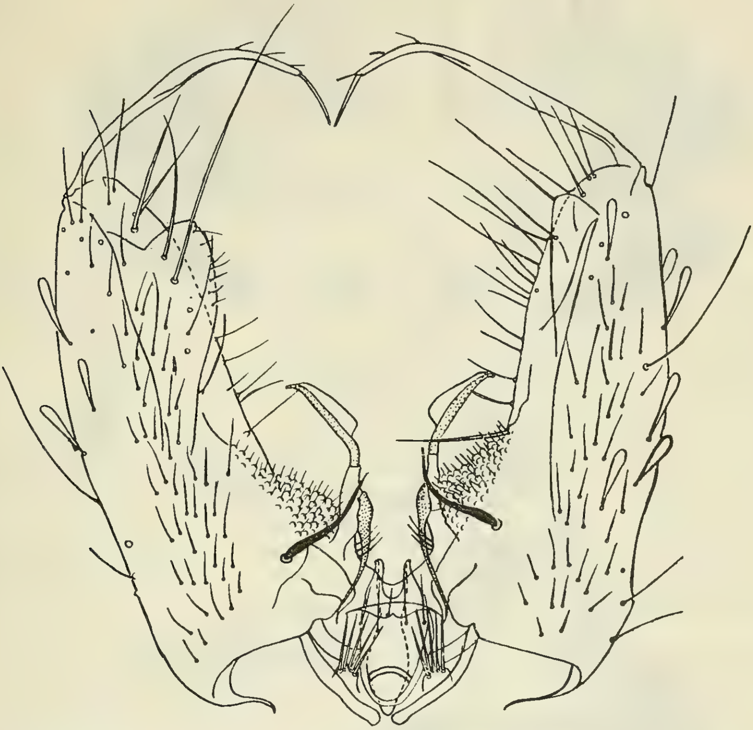

FIGURE 128. Hypopygium of Aedes flavescens Müll.

Hypopygium (Figure 128): basal lobe of coxite with a very thick, dark spine; the lobe is slightly flattened, and densely covered with short hairs on small tubercles. Claspette with a short, straight stem, wing short, with a manubrium and a distinct, plate-shaped widening in the apical half.

Fourth-stage larva (Figure 129) large, semitransparent, yellowish brown. Frontal hairs secondarily feathered, outer hairs with 6—9 branches, median hairs with 2—4 (usually 3) branches, situated before the inner hairs with 2—4 branches; postclypeal hairs very small, with 2—3 branches, situated between the median hairs. Antenna short, less than half as long as the head, with distinct spines and a tuft with 5—8 branches, with slight secondary feathering, situated in the middle, slightly more basally, and slightly more than half as long as the antenna.

Comb on 8th abdominal segment with 17—36 (usually 20—27) scales in 3 rows; scales with a long, pointed main spine and with narrow basal part and distinct spines at the margin at the base. Siphon (Figure 130) straight,

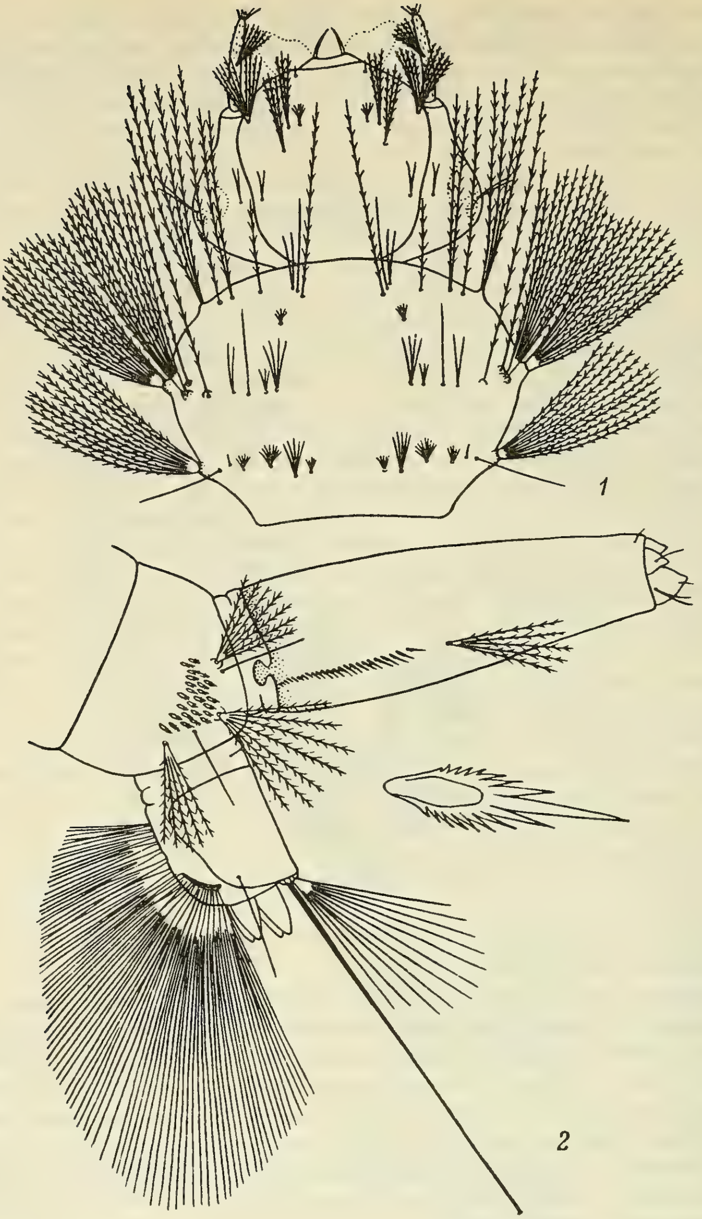

FIGURE 129. Aedes flavescens Müll. Fourth-stage larva (after Carpenter and La Casse):

1 – anterior end, dorsal; 2 – posterior end, lateral.

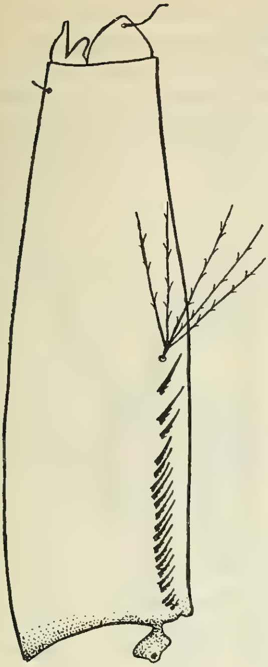

FIGURE 130. Aedes flavescens Müll. Fourth-stage larva. Siphon.

tapering from the middle, index 3.2—4.0. Pecten not reaching middle of siphon, consisting of 17—28 (usually 19—22) denticles, the distal 3 denticles more widely spaced, or not; exact determination is difficult. Hair tuft situated in the middle, with 4—7 (usually 5—6) secondarily feathered branches, $^1/_4 - ^1/_3$ as long as the siphon.

Saddle of last segment extending beyond middle of sides; lateral hair simple, as long as the saddle, outer caudal hairs simple, longer than the siphon, inner hairs forming a fan with 12—13 branches, half as long as the outer hairs. Fin with 18—19 tufts on the common base and 6—7 shorter tufts before the base. Gills of varying length, shorter than the saddle to twice as long, not pigmented, the upper pair longer than the lower.

Distribution. From the Atlantic to the Pacific; to Karelia and Yakutsk in the north, to Transcaucasia, Middle Asia, North China (Tsaidam) and Mongolia. North America, nearly to the Arctic Circle in Alaska.

Biology. The larvae are found in small, open or large water bodies on meadows or floodplains in swamps formed by snowmelt or by the flooding of rivers and lakes in spring, overgrown with vegetation. Their development is slow and the flight of females takes place at the end of spring and continues to the end of summer. One generation per year. Hibernation in the egg stage.

221 In many parts of the zone of mixed forests and forest-steppe they appear in large numbers although they are not usually considered as mass species. They enter inhabited areas but rarely enter houses. They bite people and farm animals.

Bacteria of the tularemia were found in A. flavescens during 20 days in the laboratory, infectivity by bite during 16 days, and bacteria in the feces 14 days after experimental infection (Olsuf'ev, 1941a).

11. Aedes (Ochlerotatus) cyprius Ludlow, 1920
(freyi Edwards, 1921)

Large, rust brown mosquitoes, differing from A. flavescens in the lighter color of the females; males of darker coloration.

Proboscis and palps with brown and yellowish scales. Mesonotum with light golden or ocher yellow scales, sometimes with a weakly marked darker longitudinal stripe. Integument of mesonotum light brown in females, dark brown or brown in males. Pleurae of thorax with yellowish white scales. Scales not covering dorsal mesepisterna completely, forming two more or less separated spots. Lower mesepimeral setae present. Tarsi with broad, light yellow rings, contrasting with the dark color of the distal part of each segment. On the middle segments of the hind tarsi the ring is about $^2/_3$ as long as the segment. Wings with brown and yellow 222 scales, yellow scales usually predominating. The color of the wings and legs is not as variegated in males as in females. Dark scales predominate on the wings. Abdominal tergites with ocher yellow scales and a few dark scales.

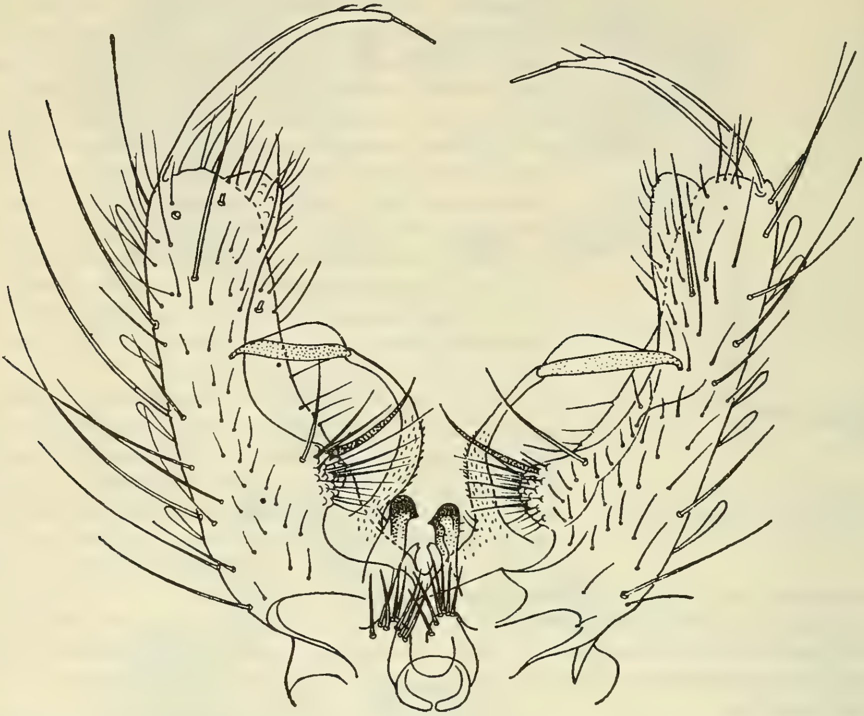

FIGURE 131. Hypopygium of Aedes cyprius Ludl.

Hypopygium (Figure 131): basal lobe of coxite conical, with one spine and thin setae; stem of claspette long, slightly curved; wing of claspette without manubrium, plate-shaped widening most distinct in the middle.

Fourth-stage larva (Figure 132) large, dark, not transparent, with bright yellow head and siphon. Entire body of larvae from the 2nd stage onward, densely covered with dark, small chaetoids in dense transverse rows. The larvae differ sharply from other species of Aedes in this character.

Outer frontal hairs with 2—3 branches, median hairs situated before the inner hairs, both pairs with 2 branches, rarely simple; postclypeal hairs thin, often simple. Antenna short, slightly curved, thicker at the base, with small spines and a tuft with 1—3 branches in the middle.

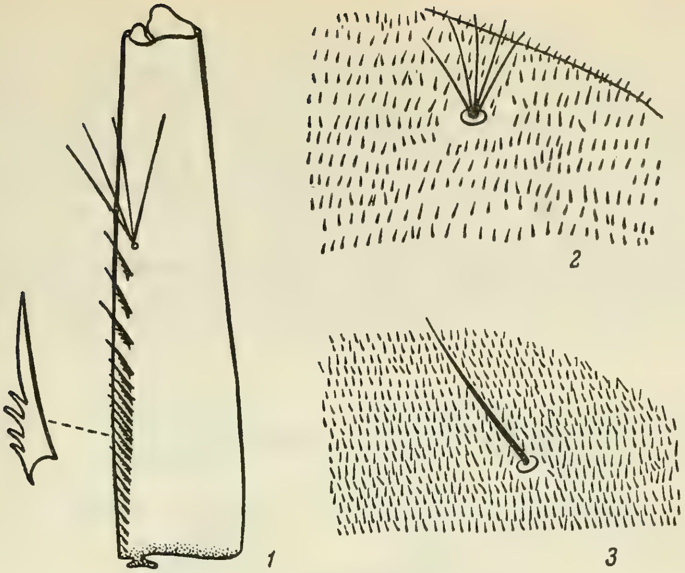

FIGURE 132. Aedes cyprius Ludl. Fourth-stage larva:

1 – siphon, lateral; chaetoids on cuticle of 3rd-stage larva (2) and 4th-stage larva (3).

Comb of 8th abdominal segment 9–15 (usually 10–12) scales in two irregular rows, each scale with a large, pointed main spine and several shorter spines at the sides of the base. Siphon long, gradually tapering (index 4.0–4.6); pecten with 17–27 (usually 20–21) denticles, the 2–3 distal denticles larger and more widely spaced; tuft situated in the middle, slightly distal to it, with 3–4 thin branches which are longer than the width of the siphon at the base.

Saddle of last segment extending to middle of sides; lateral hair simple;
223 outer caudal hairs simple, distinctly longer than the siphon, inner hairs
forming a fan with 9–10 branches, half as long as the outer hairs. Fin with 16–18 tufts on the common base and with 3–6 (usually 4–5) short tufts before it. Gills as long as the saddle, or at most 1.5 times longer, lanceolate, pigmented.

Distribution. Forest and forest-steppe of the Palaearctic from Western Europe to Khabarovsk and the Maritime Territory. It extends to the southern taiga (to 63° in Karelia) to the Ukrainian steppe and Central Kazakhstan in the south.

Biology. The larvae develop in large, 40–80-cm-deep water bodies formed by snowmelt or by floods of rivers, with banks overgrown with shrubs and herbaceous vegetation. They occur together with the larvae of A. flavescens, A. excrucians, A. cantans, A. riparius and other species but do not adhere to the banks, preferring greater depths with lower temperatures. A mid-spring species with one generation. Hibernation in the egg stage. The females attack man and animals and sometimes are vicious bloodsuckers, especially in Siberia.

rusticus group

This group contains four relatively rare species, *A. rusticus*, *A. refiki*, *A. lepidonotus* and *A. subdiversus* with a characteristic hypopygium: basal lobe of coxite with a group of elongate, transparent, lanceolate scales. The females do not have such a distinct character. The *rusticus* group differs from the two preceding groups in the absence of light rings on the tarsi. The scales on the proepimera are usually broad and straight (differing from the *communis* group).

The larvae differ in the presence of additional hairs on the siphon besides the pair of tufts in its middle which is usual for *Aedes*: 2—3 pairs of thick hairs on the anterior surface and one pair of thinner and shorter hairs on the sides near the distal denticles of the pecten.

12. Aedes (Ochlerotatus) rusticus Rossi, 1790
(diversus Theobald, 1901)

Large mosquitoes, characterized by the dark color of the broad scales on the dorsal part of the proepimera.

(224)

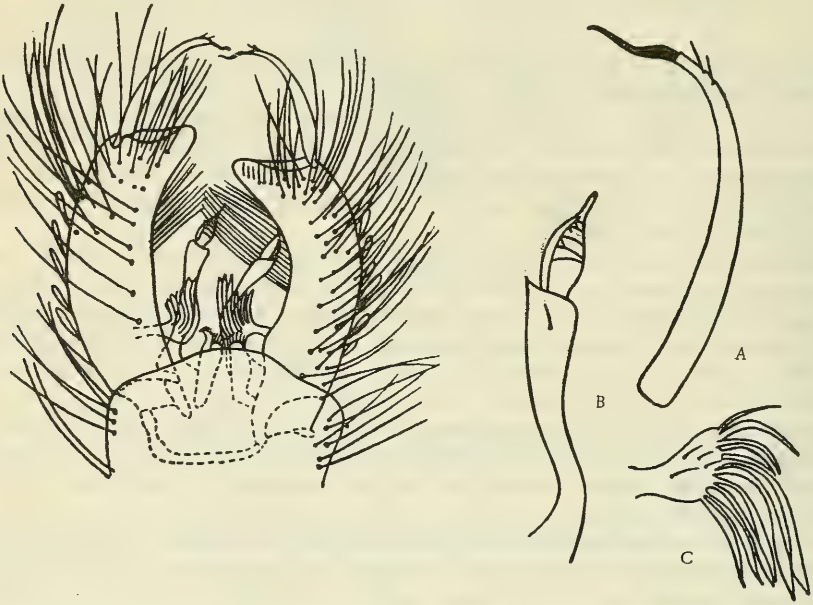

FIGURE 133. Hypopygium of *Aedes rusticus* Rossi (after Natvig): A — style; B — claspette; C — basal lobe of coxite. High magnification.

Proboscis and palps with black scales. Mesonotum with golden bronze scales, with 2 longitudinal, dark brown or black stripes, which are more distinct in the anterior half; there may also be 2 more lateral, narrow dark stripes in the posterior half of the mesonotum. Tarsi mainly with dark scales. Dark scales predominate on the wings but there are also some light scales. Abdominal tergites with light basal stripes which are widened in the middle, sometimes forming a nearly continuous longitudinal light stripe.

Hypopygium (Figure 133): basal lobe of coxite with a group of lanceolate scales, without spines or large setae; appendage of style twisted; stem of claspette long, wing short, irregular, without plate-shaped widening.

(225)

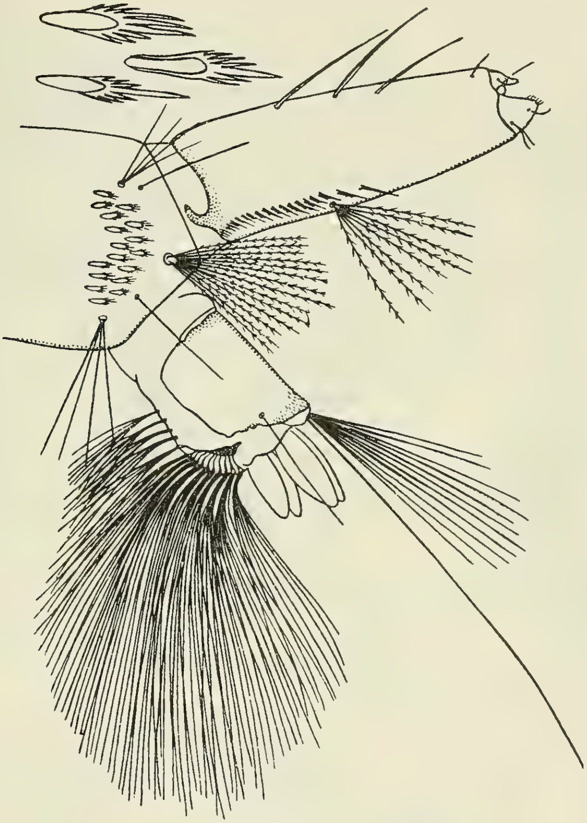

FIGURE 134. Aedes rusticus Rossi. Fourth-stage larva. Posterior end, lateral (after Marshall).

Fourth-stage larva (Figure 134) large, brown to nearly black.
224 Outer frontal hairs usually with 8 branches, median hairs with 2 (rarely 3) branches, situated before the inner hairs, which have 3 (rarely 2) branches.

Antennae short, about half as long as the head, thin, nearly straight, covered with spines; hair tuft situated near the middle, slightly basal to it, with 5—6 secondarily feathered branches, half as long as the antenna.

Comb with 12—18 (usually 14—15) scales in 2 irregular rows; scales with a long, pointed main spine, 1—2 shorter lateral spines and thin spines at the base. Siphon straight, long (index 3—3.5), tapering from the basal half. Pecten extending in $^2/_5$ of siphon, consisting of 15—25 densely arranged denticles which are longer distally; the pecten continues in 1—3 longer, widely spaced spines which do not extend to the apical third of the siphon. Hair tuft situated in middle of siphon between the distal denticles, usually with 6—8 secondarily feathered branches. On the anterior surface of the siphon are 3 (rarely 4) pairs of long, thick, secondarily feathered, sometimes branched hairs; a pair of thinner hairs with 1—2 branches on the sides beyond the middle of the pecten.

Saddle extending beyond middle of sides of last segment; lateral hair simple, nearly as long as the saddle; outer caudal hairs long and thick, inner hairs forming a fan with 7—9 branches, nearly half as long as the outer hairs. Fin strongly developed, usually with 16 tufts on the common base and 3—4 shorter tufts before it. Gills nearly half as long as the saddle, elongate-leaf-shaped, the upper pair longer than the lower.

Distribution. Western, Central and Southern Europe, to Scotland and Denmark in the north. North Africa, Asia Minor (var. subtrichurus
225 Martini, 1927, in which the scales of the mesonotum are usually golden brown, whitish on the sides). In the USSR it occurs in the Carpathians. Records from the Leningrad Region need confirmation.

Biology. The larvae occur in puddles and temporary pools with herbaceous vegetation in forests, partly shaded by shrubs and trees, rarely in open, permanent ponds. They are found together with the larvae of A. leucomelas and A. cantans. The annual cycle changes in the south. Eggs, larvae and fertilized females may hibernate according to the conditions. If the water dries up, there is one generation per year. The females are vicious biters but are not mass bloodsuckers.

13. Aedes (Ochlerotatus) refiki Medschid, 1928

It differs from A. rusticus in the coloration of the abdominal tergites and the structure of the hypopygium.

Proboscis and palps with black scales, sometimes with some light scales. Mesonotum with yellowish scales and a broad, dark, longitudinal stripe or with two stripes close together. Pleurae of thorax with spots of white scales; scales of proepimera straight, 2-colored, whitish in the lower part, dark brown or black in the upper part. Postcoxal and hypostigmal spots of scales present. Fore and mid-femora and tibiae with brown and light scales anteriorly. Tarsi dark. Wings mainly with dark scales, base of radius with light scales. The coloration of the abdomen varies markedly. The tergites are often covered with black scales and with an indistinct white stripe at the base; the white stripes are often reduced, sometimes to small spots at the sides; there may also be narrow, light stripes at the apex of the tergites; sometimes the light scales predominate and there are only a few dark scales.

Hypopygium (Figure 135): basal lobe flattened, situated nearly in the 226 middle of the inner surface of the coxite, covered with lanceolate, transversely striated scales; near the lobe is another tubercle with 2—3 long setae. Stem of claspette long, wing elongate, transversely striated. The elongate appendages of tergite 9 bear 7—10 short, strong setae. Very long setae at the posterior margin of sternite 8.

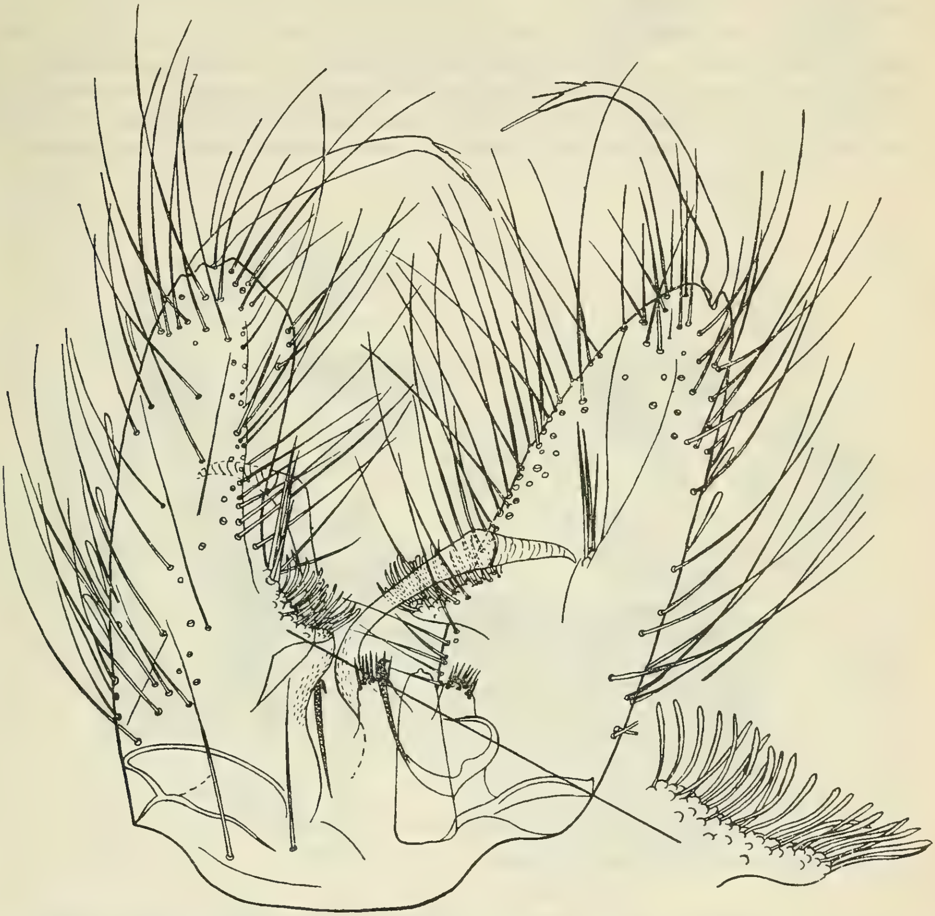

FIGURE 135. Hypopygium of Aedes refiki Med.

Fourth-stage larva (Figure 136) small and less strongly pigmented than that of A. lepidonotus. Outer frontal hairs with 6—9 branches, median hairs simple, rarely with 2—3 branches; inner hairs situated behind the median hairs, with 2—5 (usually 3) thick, dark, secondarily feathered branches; postclypeal hairs short, thin, with 3 branches. Antenna short, slightly curved, with spines; hair tuft with 12—15 short, thin branches.

Comb on 8th abdominal segment with 6—11 scales in an irregular row with a well developed, pointed main spine and several shorter lateral spines

at the base. Siphon straight, slightly tapering apically (index 3.0–4.0, rarely more); pecten with 12–21 (usually 13–16) densely arranged denticles and 1–2 widely spaced, large, smooth spines slightly extending beyond basal third of siphon. Hair tuft with 6–9 strongly developed, secondarily
227 feathered branches situated in middle of siphon but slightly basal to it; on the anterior surface are 3 pairs of thick, secondarily feathered hairs and on the lateral surfaces a pair of thin hairs with 2–5 branches near the distal spines of the pecten.

Saddle of last segment extending nearly to lower margin of sides; lateral hair with 1–3 long, secondarily feathered branches; outer caudal hairs long, simple, inner hairs $^3/_4$ as long, usually with 9 branches. Fin well developed, with 15 tufts on the common base and 2–3 tufts before it. Gills leaf-shaped, with rounded ends, as long as the saddle, slightly pigmented.

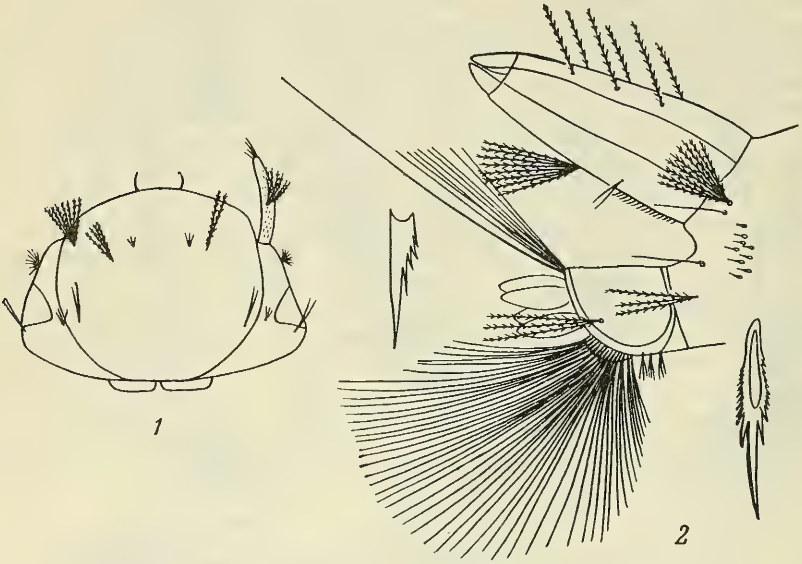

FIGURE 136. Aedes refiki Med. Fourth-stage larva (after Medschid):

1 – head, dorsal; 2 – posterior end, lateral.

Distribution. Southern and Central Europe (Spain, France, East Germany, West Germany, Czechoslovakia, Hungary, Yugoslavia); Asia Minor. In the USSR it has been recorded only from Simferopol on the southern coast of the Crimea. A rare species.

Biology. The larvae have been found in the Crimea in early spring in water with turf holes with grass or clay bottom and with fallen leaves. Hibernation in the egg stage. Development begins at the end of February and flight at the end of April. Summer populations develop only if water is present where the eggs are deposited. Bites man (Velichkevich, 1936).

14. Aedes (Ochlerotatus) lepidonotus Edwards, 1920

The species differs in the presence of scales on the postnotum.

(228)

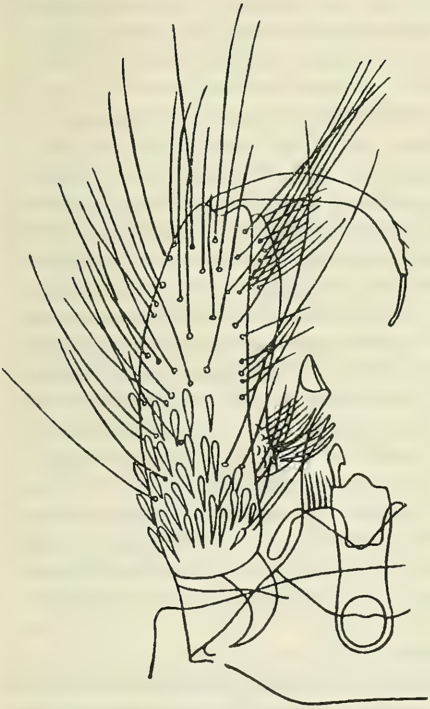

FIGURE 137. Hypopygium of Aedes lepidonotus Edw.

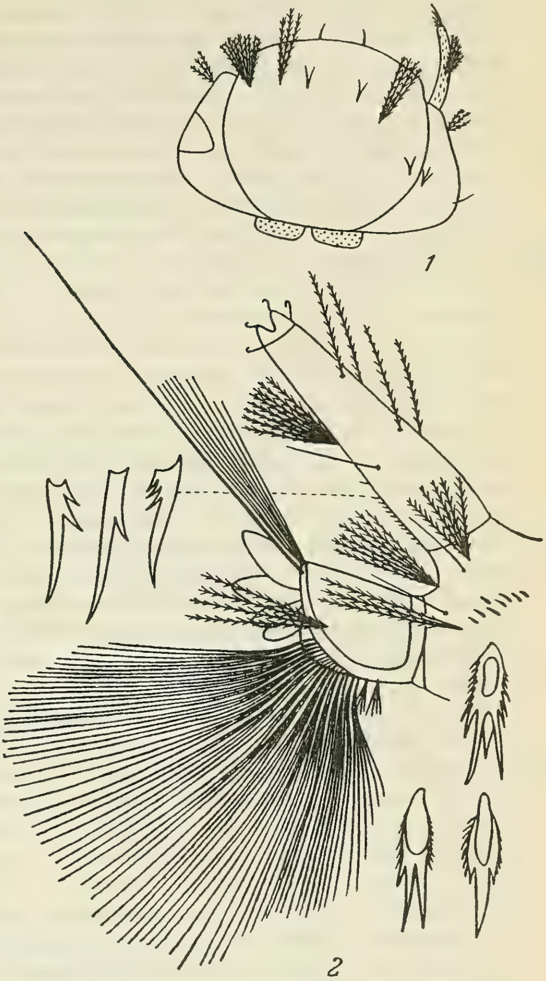

FIGURE 138. Aedes lepidonotus Edw. Fourth-stage larva (after Medschid):

1 – head, dorsal; 2 – posterior end, lateral.

Head dorsally with yellowish scales and black, upright scales lateral to them; lateral parts of head with white scales. Proboscis black. Palps of female a third as long as the proboscis, black, with a few white scales. Palps of male mainly covered with white scales; apex and, sometimes, base of segments with black scales; last segment distinctly thickened, with tufts of long hairs, yellow hairs with black apex on the penultimate segment and 228 black hairs on the last segment. Mesonotum with light yellow scales; pleurae of thorax densely covered with white scales; postnotum with a group of light yellow scales. Legs: femora and tibiae with yellowish white scales, except at the apex, which is covered with black scales; tarsi with black scales and with some white scales at the base of the first segment. Wings mainly covered with yellowish white scales except on the costa and r_1, which are covered with dark scales. Abdomen usually covered with light grayish scales. The middle of the tergites is sometimes nearly completely covered with black scales, especially in males.

Hypopygium (Figure 137): coxite with weakly developed basal lobe with a tuft of narrow scales; a process with long setae near the basal lobe absent; apical lobe hardly distinguishable; claspette with straight, thick stem and a short wing of irregular form.

229 Fourth-stage larva (Figure 138) medium-sized. Outer frontal hairs with 8—10, median hairs with 1—3, inner hairs with 3—4 branches, situated behind the median hairs; all hairs secondarily feathered; postclypeal hairs short, thin, with 2—3 branches. Antennae less than half as long as the head, with spines; hair tuft with 5—6 secondarily feathered branches, half as long as the antenna, situated slightly basal to the middle.

Comb with 6—11 large scales in an irregular row, scales with a pointed main spine and lateral spines at the base or lateral spines as large as the main spine, which may be rudimentary or absent. Siphon straight, of varying form (index 2.5—4.0), tapering from the basal third. Pecten with 9—21 (average 14—16) denticles of varying number according to the length of the siphon; 1—2 distal denticles more widely spaced but not extending beyond basal half; hair tuft with 8—13 secondarily feathered branches situated in the middle of the siphon, usually before the distal denticles of the pecten. On the anterior surface of the siphon are 2 pairs of thick, long, secondarily feathered hairs. There is usually a simple, smooth hair, longer than the width of the siphon, on the sides, near the distal denticle of the pecten.

Saddle of last segment extending to the lower margin of the sides; lateral hair well developed, with 3—5 long, secondarily feathered branches; outer caudal hairs simple, longer than the siphon, inner hairs two thirds as long, usually with 9 branches. Fin with 16 tufts on the common base and 2 much shorter tufts before it. Gills shorter than the saddle, leaf-shaped, upper pair slightly longer than the lower.

Distribution. Greece, Turkey (Anatolia).

Biology. The larvae occur in waters formed by spring floods, slightly saline, often together with A. detritus. One generation per year in early spring. Hibernation in the egg stage.

Note on systematics. A. albescens Edwards, 1921 was described from Siberia and synonymized by Martini (1931) with A. lepidonotus. Edwards writes that A. albescens is related to A. lepidonotus, but the postnotum (postscutellum) is without scales. Nearly all the scales on the body are whitish but brown on the greater part of the proboscis and on the palps. The scales on the proepimera are whitish, narrow, some of them curved. Palps of female long, a third as long as the proboscis. Wing membrane whitish; all scales at anterior margin of wing whitish yellow, some scales on the radius dark, whitish yellow on the legs, brown on the last tarsal segments; tarsi without white rings. Claws: formula 1:1, 1:1, 1:1. Siberia: Omsk (Granö); one female in the museum in Helsinki. Martini (1931), who examined this specimen, stated that one scale was distinctly preserved on the postnotum and that there were several dots, probably the points where the scales had fallen off.

Because of this description of A. albescens and the synonymy of albescens and lepidonotus, we identified the mosquitoes of the group rusticus from North Kazakhstan as A. lepidonotus, but as we have not found larvae, males or mosquitoes with scales on the postnotum which would correspond to the description of this species, we think that the mosquitoes of the group rusticus from Siberia and Kazakhstan should be considered as A. subdiversus (see below). The status of A. albescens Edw. is not clear: it is either identical with a species of the rusticus-lepidonotus group or with subdiversus. We suggest that A. lepidonotus has not been found in the USSR and that A. albescens is a doubtful species.

230 15. Aedes (Ochlerotatus) subdiversus Martini, 1926

The species differs from the three preceding species of the rusticus group in the structure of the hypopygium. Head with light and dark scales dorsally. Proboscis and palps (female) with black scales, often also with some light scales. Mesonotum with a broad, sometimes indistinct, longitudinal stripe of bronze or yellowish brown scales which consist apparently of three small stripes, lighter in the middle and darker laterally. Pleurae of thorax with spots of silvery or yellowish cream-colored scales. Upper half of proepimera with yellowish or darker, bronze, straight or slightly curved scales. Postcoxal and hypostigmal spots of scales present, the latter forming part of a longitudinal stripe below the anterior spiracle. Legs: femora and tibiae of fore legs variegated anteriorly; tarsi brown, without white rings but with a large admixture of light scales. Wings mainly with dark scales, light scales mainly at the base and on some veins, mainly in the anterior part of the wing. Abdomen: tergites with whitish gray or cream-colored scales, often with some dark scales, which sometimes form indistinct spots; proportion of light and dark scales on abdomen strongly varying.

Hypopygium (Figure 139): style straight or slightly sickle-shaped (not undulant); basal lobe of coxite with narrow, lanceolate scales, and near it a small process with 2–3 long and some shorter setae; stem of claspette
231 long, with short wing, not transversely striated; phallosome sclerotized, serrated at the apex, with a constriction in the middle; appendages of tergite 9 with 8–10 short, thick setae; posterior margin of sternite 8 densely covered with long, thin hairs in the middle.

Fourth-stage larva large, yellowish brown, with slightly paler head and siphon.

Head 1.5 times wider than long. Frontal hairs slightly secondarily feathered, outer hairs with 5, median hairs with 2–3, inner hairs with 2 branches; median hairs situated before the inner hairs, slightly more widely spaced; between them are the 2-branched postclypeal hairs. Antennae half as long as the head, covered with spines, hair tuft situated in the middle, with 3 branches, about a third as long as the antenna. Mouth parts of the mixed type, substrate and planktonic, as in A. rusticus.

Comb with 12–17 (usually 14–15) scales with a long, pointed main spine and small denticles at the base, usually in 2 irregular rows. Hairs behind comb as in A. rusticus. Siphon (index 3–3.3) with pecten occupying about $^2/_5$ of its length and consisting of 11–16 denticles, 2–5 near the base rudimentary; 1–2 distal denticles larger and more widely spaced. Each denticle in the form of a spine with accessory spines at the base. Between the distal denticle of the pecten and the apex of the siphon are 3–4 smooth, longer spines. Hair tuft in the form of a long, simple hair near the distal denticle of the pecten or slightly apical to it. Lateral to the median denticles of the pecten is a thin, 2-branched hair. On the anterior surface of the siphon are 3–4 pairs of long, slightly secondarily feathered hairs, sometimes arranged in a zigzag row.

(230)

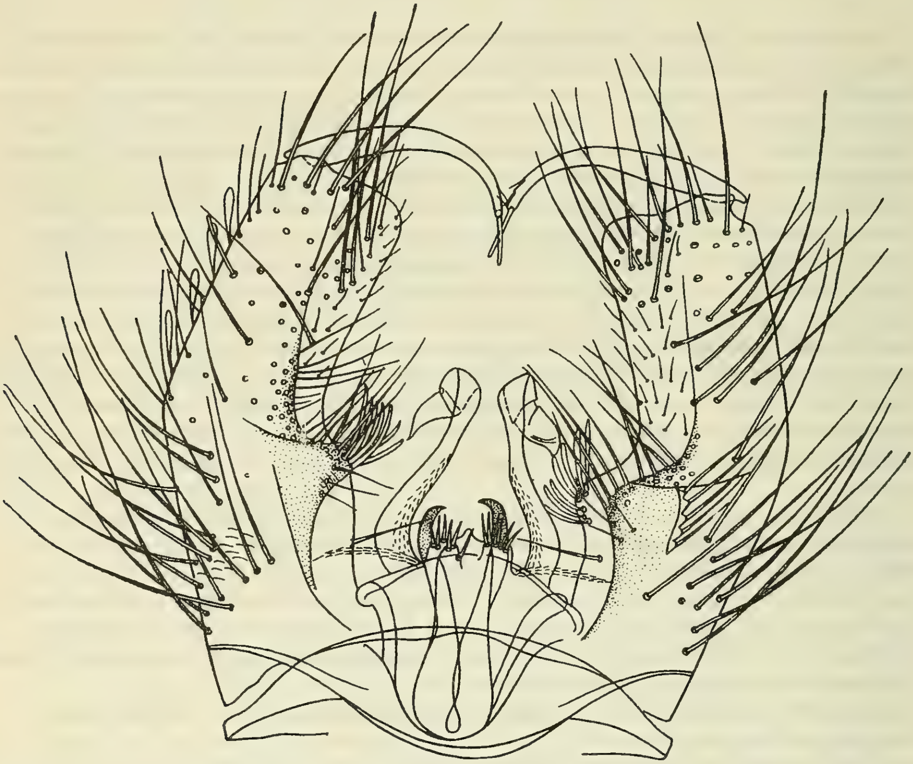

FIGURE 139. Hypopygium of Aedes subdiversus Mart.

Saddle of last segment covering about $^3/_4$ of the sides. Outer caudal hairs simple, as long as the siphon, inner hairs forming a fan with 11 branches. Fin with 14—15 tufts on the common base and 6—7 shorter tufts before it. Gills and lateral hairs were damaged in the specimens available.

Note on systematics. The species varies widely in coloration. The light variants which we identified as A. lepidonotus in the past (see above) have light scales on the tergites, a large admixture of light scales on the palps and proboscis of the female, and lighter scales in the dorsal half of the proepimera. There are transitions between the "typical" forms and the light variants.

Distribution. From the Volga (the species was described from the Saratov Region; Martini, 1926, 1928) to Transbaikalia. Common in Kazakhstan and southern Siberia. The boundaries of the distribution area have not been determined.

Biology. One generation per year in spring. Mass attacks on people and farm animals have been observed in some localities, e.g. in the Kustanai Region.

communis group

Usually medium-sized mosquitoes. They differ from the species of the caspius and cantans groups in the dark tarsi without light rings and from those of the rusticus group in the structure of the hypopygium. This large heterogeneous group contains 16 Palaearctic species, some of them mass bloodsuckers. They usually predominate among mosquitoes
232 inhabiting forests and tundra and attack people and farm animals. They usually bite in the open, but when they are numerous, they enter houses and cattle sheds.

Most species of this group have only one spring generation. After the rains, there may be a small summer generation, much smaller than the spring generation. The seasonal curve of activity of this group has usually one peak, with the maximum at the end of spring and in early summer. In the northern taiga and tundra, where most of the mosquitoes of this group are found, they appear in small numbers in the middle or at the end of summer.

An important systematic character is the arrangement of the spots of scales on the pleurae of the thorax (Peus, 1933; Figure 99). The scales are easily lost and the females of the communis group can therefore be determined reliably only from well preserved specimens. Determination can be certain only by the hypopygium of the males and by the larvae.

16. Aedes (Ochlerotatus) communis De Geer, 1776
(nemorosus Meigen, 1818)

Medium-sized, differing from related species in the absence of a post-coxal spot of scales and the structure of the hypopygium.

Palps of female and proboscis with brown scales. Last segment of palps of male thickened. Mesonotum with golden yellow or bronze scales,

usually with 2 approximate longitudinal dark stripes which may be fused, or sometimes indistinct or absent. Pleurae of thorax with white scales without silvery sheen. Postcoxal spot absent, i. e. scales absent on the small membranous part between the base of the fore coxae and the anterior
233 margin of the mesepisternum. Spot of scales on the mesepisterna extending to the anterior corner. Spot of light scales below the anterior spiracle (hypostigmal spot) absent. Scales on the mesepimera extending to the lower margin. Tarsi with blackish brown scales, sometimes with a few gray or whitish scales. Wings with dark scales; light scales only for a short distance on the base of the costa. Abdomen with transverse white stripes dorsally near the anterior margin of the tergites, other part of tergites with dark scales; stripes on abdominal segments 2—5 more or less of the same width, not distinctly narrower in the middle.

(232)

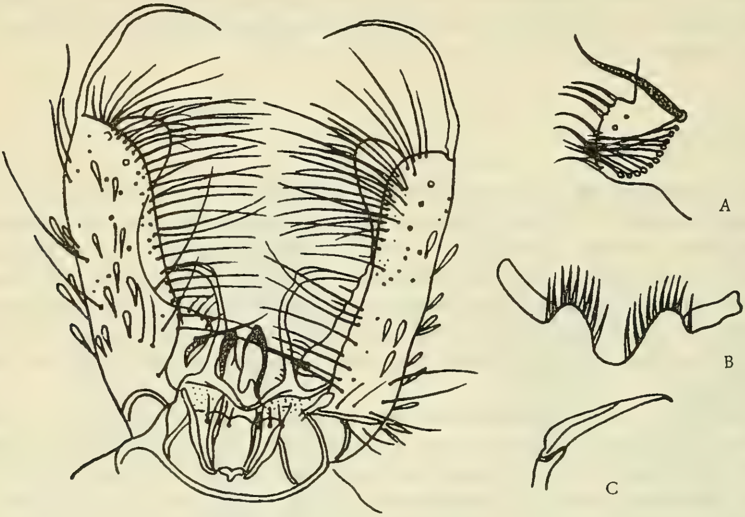

FIGURE 140. Hypopygium of Aedes communis Deg. (after Natvig):
A — basal lobe of coxite; B — lobes of tergite 9; C — wing of claspette. High magnification.

Hypopygium (Figure 140): coxite with long hairs and well developed basal and apical lobes. Basal lobe half-rounded, with a long spine; a row of short hairs curved to one side at the inner margin of the lobe. Stem of claspette long, straight or slightly curved, wing very narrow, long, not widened, slightly sclerotized.

Fourth-stage larva (Figures 141—143) large, of varying color, usually dark. Frontal hairs secondarily feathered, outer hairs with 4—8
234 branches, median hairs situated before the inner hairs, both pairs simple, rarely one of the hairs with 2, exceptionally with 3, branches; postclypeal hairs thin, short, with 3—4 branches. Antenna about half as long as the head, covered with spines and slightly curved, with a hair tuft with 6—7

(233)

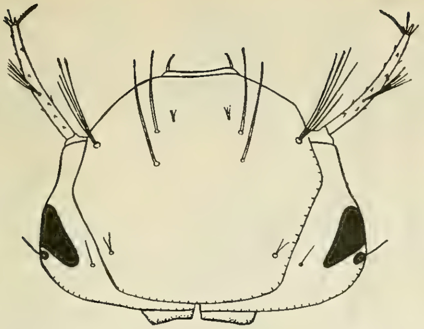

FIGURE 141. Aedes communis Deg. Fourth-stage larva. Head, dorsal.

branches in the middle, not half as long as the antenna.

Comb usually with 60–80 scales forming an irregular triangular spot, scales without a main spine, their distal end with a row of pointed spines which sometimes extend to the lateral margin. Siphon tapering from the middle, index 2–3 (average 2–7). Pecten with 17–26 (usually 21–22) closely spaced denticles, the 1–4 basal denticles rudimentary, the others becoming longer apically; pecten not extending to middle of siphon. Hair tuft with 5–9 (usually 6–7) secondarily feathered branches situated in the middle, about a third as long as the siphon.

Saddle extending to middle or lower margin of last segment; lateral hair short, simple; outer caudal hairs simple, longer than the siphon, inner hairs forming a fan with 6–8 shorter branches. Fin with 16–19 tufts on the common base and 2 shorter tufts before it. Gills long, 1.5–2 times as long as the saddle, pigmented, with pointed ends.

(233)

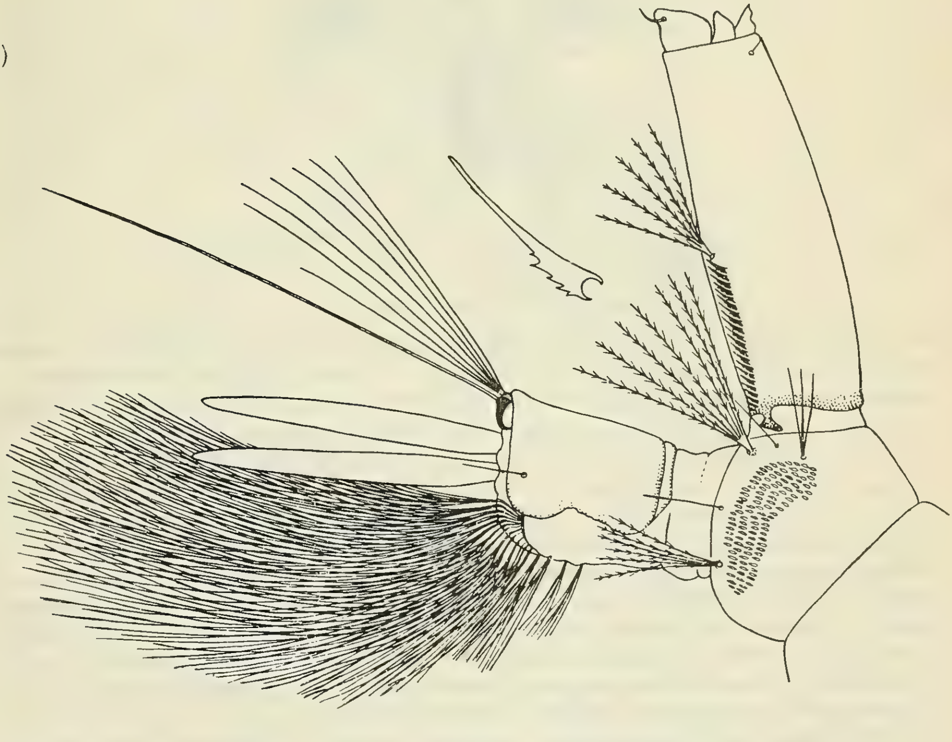

FIGURE 142. Aedes communis Deg. Fourth-stage larva. Posterior end, lateral.

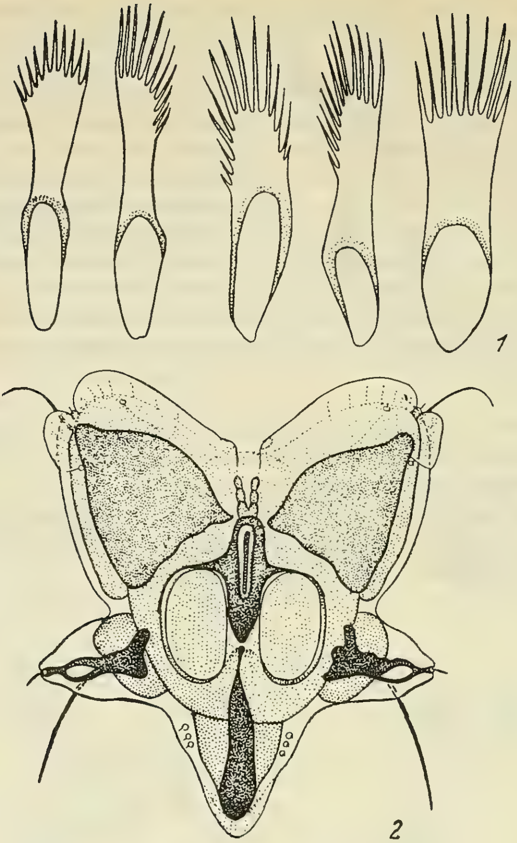

FIGURE 143. Aedes communis Deg. Fourth-stage larva:

1 – scales of comb; 2 – stigmal plate.

Distribution. Forest and tundra zone of both hemispheres: Europe, Siberia, Far East (USSR), North America. It extends in the north to the Arctic Ocean (Murmansk, mouth of the Kolyma), in the south to East Kazakhstan, the Northern Caucasus, Ukrainian steppes and Bulgaria.

Biology. The larvae are found in permanent and temporary water bodies formed by melting snow. Their bottom covered with fallen leaves. They are found in the south in shaded forest habitats, in open areas in the north. They may hatch from hibernating eggs while still under the ice. One generation per year, but there may be another generation in a wet autumn. After a dry spring, numerous larvae may appear with the summer rains. The forest zone is one of their most common habitats. They take
235 first place among mosquitoes attacking people and animals in many localities. Flight begins earlier than in most other species of Aedes. Their numbers decrease sharply in midsummer.

They apparently take part in the transmission of tularemia (natural infections have been found).

17. Aedes (Ochlerotatus) pionips Dyar, 1919

Resembling A. communis, but differing in the presence of a postcoxal spot of scales and in the structure of the larvae.

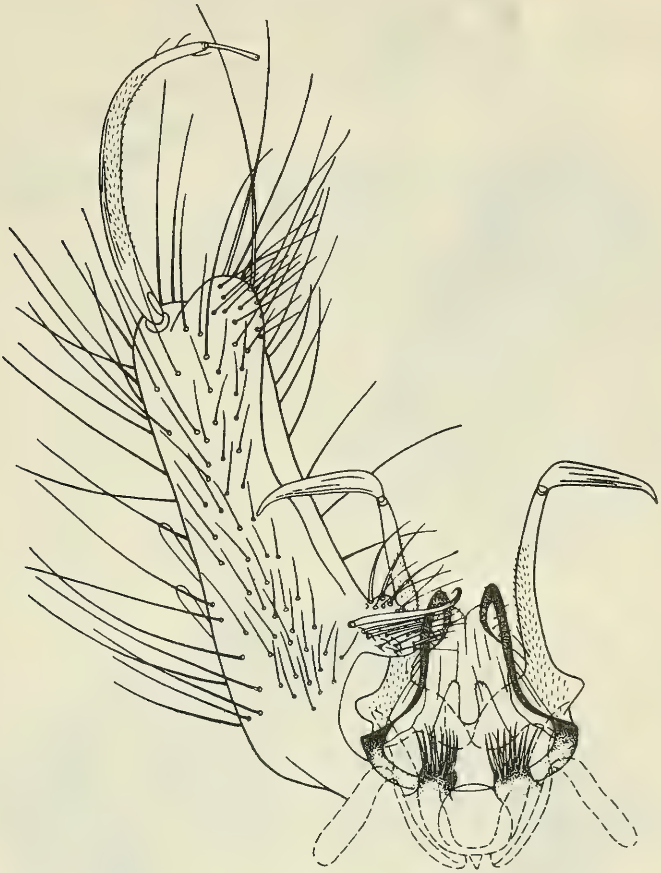

FIGURE 144. Hypopygium of Aedes pionips Dyar (after Carpenter and La Casse)

Head with light yellowish brown scales dorsally. Proboscis and palps with brown scales. Last segment of palps of male thin. Mesonotum with yellowish gray or golden bronze scales with an indistinct broad longitudinal brown stripe or 2 approximate stripes divided by a narrow stripe of golden scales. Lateral longitudinal dark stripes usually present in the posterior half of the mesonotum. Spots of scales on pleurae of thorax as in A. communis, except that there are also scales on the postcoxal membrane. Wings with dark scales and usually some light scales at the base. Abdomen

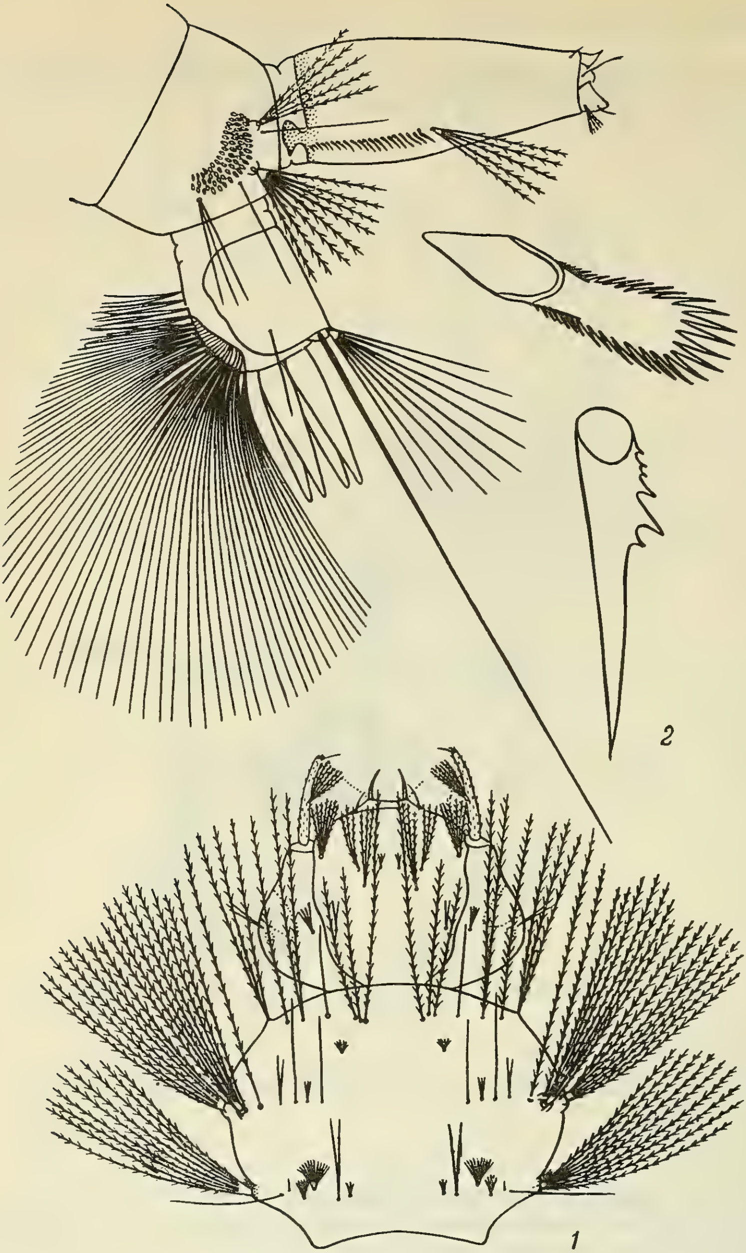

FIGURE 145. Aedes pionips Dyar. Fourth-stage larva (after Carpenter and La Casse):

1 — anterior end, dorsal; 2 — posterior end, lateral.

237 with brown scales dorsally and light transverse stripes of more or less the same width.

Hypopygium (Figure 144) as in A. communis; the differences of the hypopygium of the two species (Vockeroth, 1952) are small, apparently in the range of intraspecific variation. The hypopygia of the two species are indistinguishable for practical purposes.

Fourth-stage larva (Figure 145) large, dark brown, head 1.5 times wider than long. Antennae thin, slightly curved, more than $^2/_3$ as long as the head, covered with spines; hair tuft situated near the middle, slightly more basally, with 7–13 (average 8–9) slightly secondarily feathered branches, about half as long as the antenna. Frontal hairs: outer hairs with 5–9 (average 7–8) secondarily feathered branches, median hairs with 3–5 branches (with 3 branches in 50% of the specimens), inner hairs with 3–5 (average 4, rarely 2) branches; postclypeal hairs with 3–5 short, thin branches, situated between the median hairs.

Comb on 8th abdominal segment with 61–78 scales (average 68, rarely fewer than 60), scales oblong, slightly wider distally, their margin with a row of sometimes asymmetrical, short spines which are smaller toward the base. Siphon straight, slightly tapering, index about 3.0. Pecten with 18–24 closely spaced denticles which are longer distally and with 1–6 rudimentary denticles at the base, pecten $^1/_3$ – $^2/_5$ as long as the siphon. Hair tuft situated in the middle, with 4–9 (average 6) secondarily feathered branches. Saddle of last segment extending to $^2/_3$ of the sides; lateral hair thin, simple; outer caudal hairs distinctly longer than the siphon, simple, inner hairs with 9–14 (average 12) smooth branches, as long as the last segment. Fin with 17–21 (average 19) tufts on the common base and with 2–3 short tufts before the base. Gills lanceolate, pointed, pigmented, of varying length, as long as the saddle or twice as long.

Distribution. Alaska, Canada, Northwestern U. S. A. Until recently it has not been found in the Palaearctic (Sazonova, 1958) and has probably not been distinguished from A. communis. It occurs in the northern half of the European USSR, West and East Siberia, Khabarovsk Territory and Kamchatka. The boundaries of distribution have not been determined. Records of the wide distribution and large numbers of A. communis in northern regions refer perhaps to A. pionips and A. hexodontus (see below).

Biology. The larvae hatch from hibernating eggs in early spring in pools and other small water bodies formed by snowmelt in open and forest localities, in plains and mountain landscapes to about 1,000 m above sea level.

18. Aedes (Ochlerotatus) punctor Kirby, 1837
(meigenanus Dyar, 1921)

Closely resembling the two preceding species in coloration, differing from them in the structure of the hypopygium, the absence of light scales on the wings, and the form of the light stripes on the abdomen (with an indentation in the middle).

Proboscis and palps with blackish-brown scales. Mesonotum with golden bronze or reddish bronze scales, usually with a dark brown longitudinal

238 stripe or with 2 approximate dark stripes. Specimens with a uniformly colored mesonotum have been found. Postcoxal spot present (in contrast to A. communis). Spot of white scales extending to the anterior corner on the mesepisterna and to the lower margin on the mesepimera. Hypostigmal scales absent. Tibiae and tarsi with dark scales. Wing with dark, nearly black scales; there may be rarely a few yellowish scales at the base of the costa. The light transverse stripes on the abdominal tergites are distinctly narrower in the middle; there are sometimes only white spots at the sides of the segment connected by a narrow, light stripe at the base of the tergites.

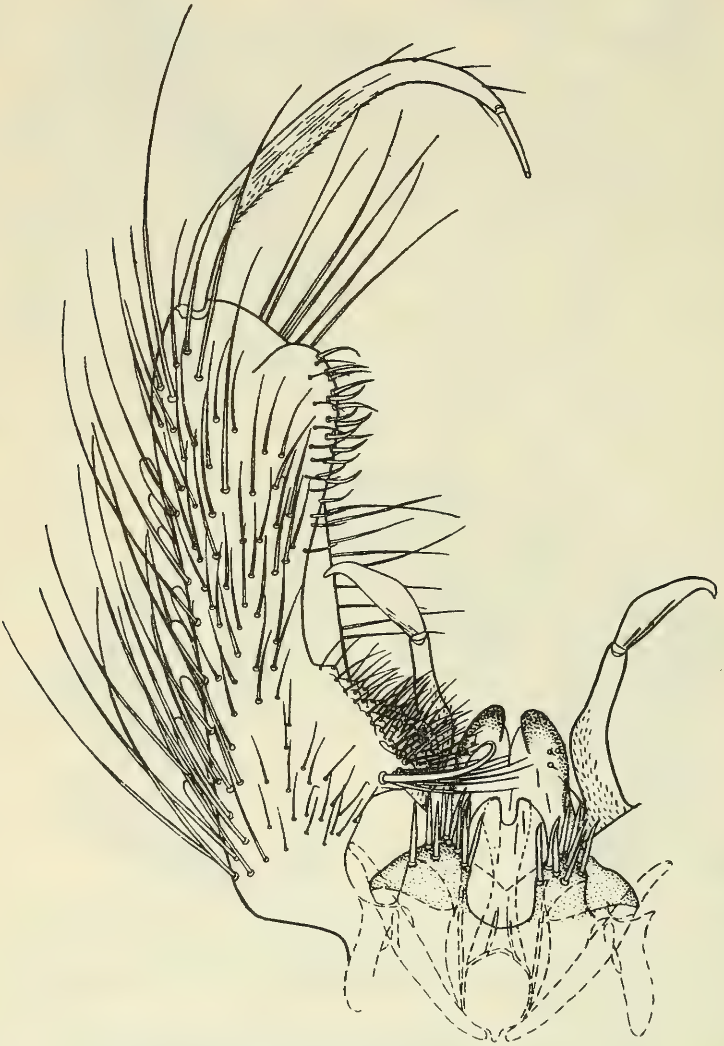

FIGURE 146. Hypopygium of Aedes punctor Kirby (after Carpenter and La Casse)

Hypopygium (Figure 146): apical lobe of coxite flattened, covered with short, curved hairs, extending proximally nearly to the middle of the coxite, 239 basal lobe with one spine, strongly convex, densely covered with short hairs on small tubercles. Claspettes with short, straight stem, wings slightly widened in the middle, long, lanceolate, 2–3 times longer than wide. The wing of the claspette is usually brown in preparations, without a transparent widening as in most species of Ochlerotatus.

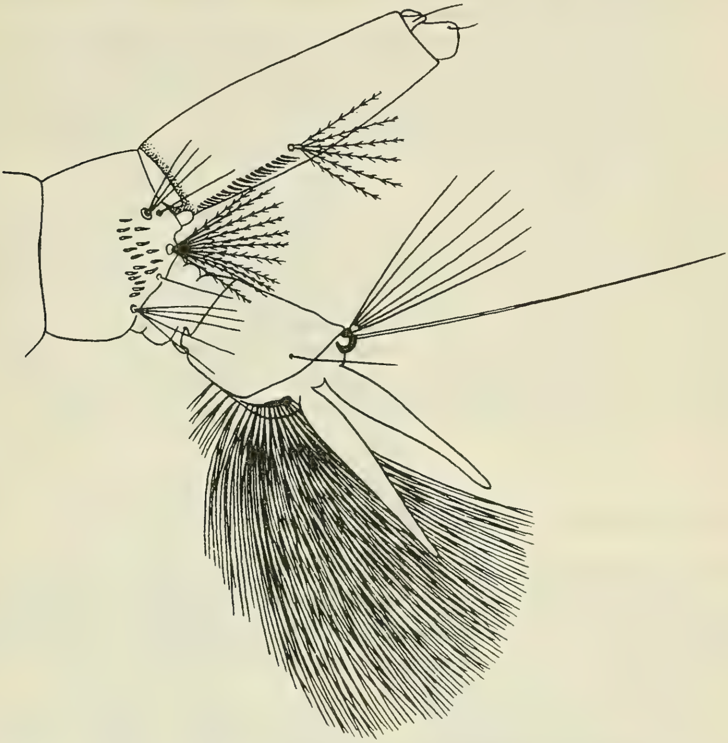

FIGURE 147. Aedes punctor Kirby. Fourth-stage larva. Posterior end, lateral.

Fourth-stage larva (Figure 147) medium-sized to large, older larvae dark brown. Frontal hairs: outer hairs with 2–8 (average 5) branches, median and inner hairs with 1–3 (usually 2) branches with slight secondary feathering; postclypeal hairs situated between median hairs, thin, short, with 2–4 branches. Antennae less than half as long as the head, slightly curved, hair tuft situated in the middle, with 4–7 branches, less than half as long as the antenna.

Comb with 11–24 (usually 14–15) small scales (0.07–0.08 mm), with a main spine and small spines at the base, arranged in 2–3 irregular rows. The number of scales is very variable even on the left and right side of a specimen. Siphon straight, slightly tapering (index about 3.0); pecten distinctly not reaching middle of siphon, with 14–26 (usually 19–22) denticles, 1–6 rudimentary denticles at the base; denticles closely spaced, becoming longer apically; hair tuft with 3–9 (average 5) branches in the middle of the siphon, often basal to it.

Saddle surrounding last segment like a ring; on the ventral side is a deep indentation in which the anterior tufts of the fin are situated; the 240 lower margins of the ring are rarely not fused, but form a narrow median slit. Lateral hair simple, as long as the saddle; outer caudal hairs long, simple, inner hairs with 5–8 branches. Fin with 16–19 tufts on the common base and 1–2 tufts before the base. Gills long, tapering, pigmented, usually 1.5–2 times as long as the saddle.

Distribution. Forest and tundra zones of both hemispheres: Europe, Siberia, Far East, North America. Extending in the north to the Arctic Ocean and in the south to the Crimea, Northern Caucasus and Eastern Kazakhstan. It occurs in the mountains of Algeria. Its distribution to the north should be determined more exactly because the related *A. hexodontus* has been found there.

Biology. The larvae are found in small, open or partly shaded water bodies formed by snowmelt in turf or forest swamps, their bottom covered with rotting leaves, needles of conifers, moss or herbaceous vegetation. In the taiga and tundra and also in the forests of the Maritime Territory, *A. punctor* is an important bloodsucker, biting man and farm animals. It is an early spring species which appears together with *A. communis* or a little later. The mosquitoes sometimes breed again after the summer rains, but not in large numbers. Natural infections of *A. punctor* with tularemia have been found.

19. Aedes (Ochlerotatus) hexodontus Dyar, 1916

Closely resembling *A. punctor*, but differing in the light scales at the base of the wing, and from *A. communis* in the presence of a postcoxal spot of scales. It closely resembles *A. pionips*, but differs from it in its darker coloration, especially of the mesonotum. It can be reliably determined only by the larvae.

Head mainly with dark brownish bronze scales dorsally. Proboscis and palps with black scales. Mesonotum usually with rust brown scales and there is sometimes an indistinct dark longitudinal stripe. Wing with dark scales, light scales present only at the base. Light scales are sometimes few, but they often cover the base of the costa and radius to the humeral cross-vein. Abdomen with dark scales and light stripes which are usually slightly narrower in the middle, rarely of the same width. The brown scales of the tergites sometimes have a slight bronze tone and do not differ much from the grayish white scales of the stripes at the base of the segments.

Hypopygium (Figure 148). The males of *A. hexodontus* and *A. punctor* are practically indistinguishable.

Fourth-stage larva (Figure 149) dark or yellowish brown, head 1.3–1.4 times wider than long. Frontal hairs thick, with sparse secondary feathering; outer hairs with 4 (3–6) branches, median hairs situated before the inner, both pairs usually simple, rarely with 2 branches; 2-branched hairs are often found in the central and southern parts of the area of distribution. Postclypeal hairs thin, with 2–3 branches. Antennae about half as long as the head, with spines, hair tuft with 3–4 branches, not reaching the apex. Mouth parts of the mixed type, substrate feeding predominating.

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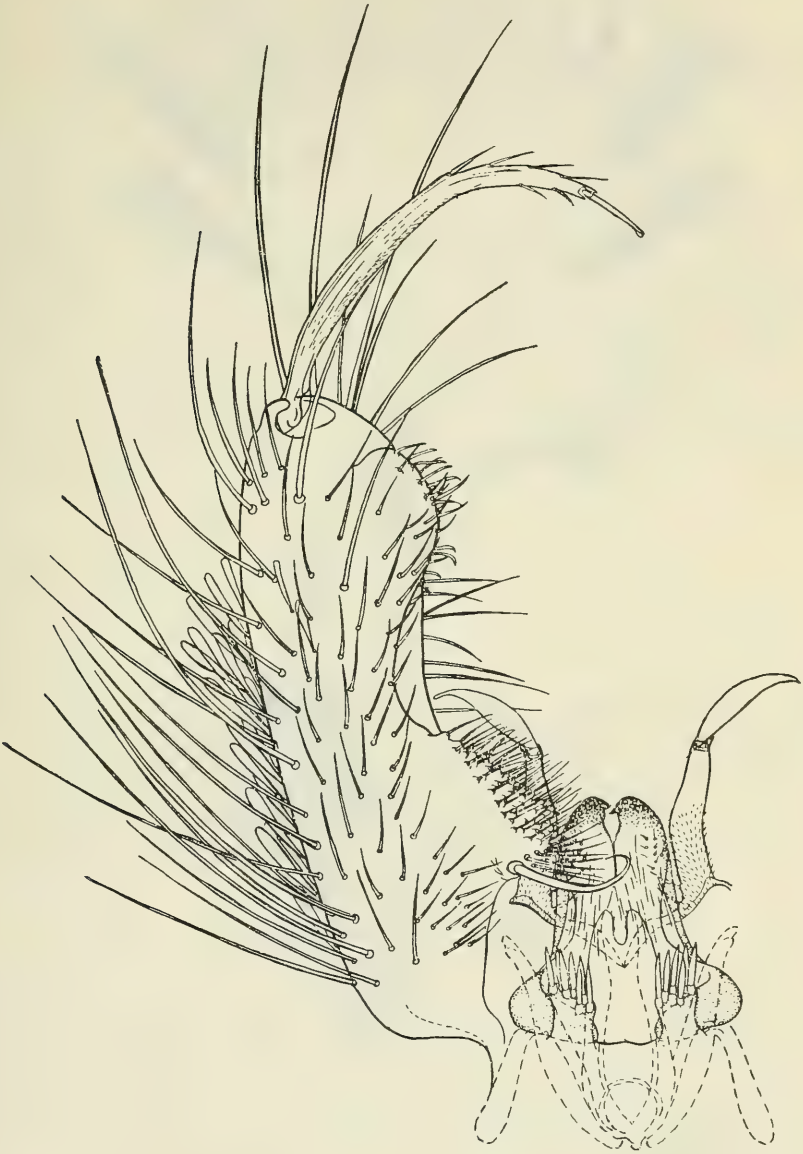

FIGURE 148. Hypopygium of *Aedes hexodontus* Dyar (after Carpenter and La Casse)

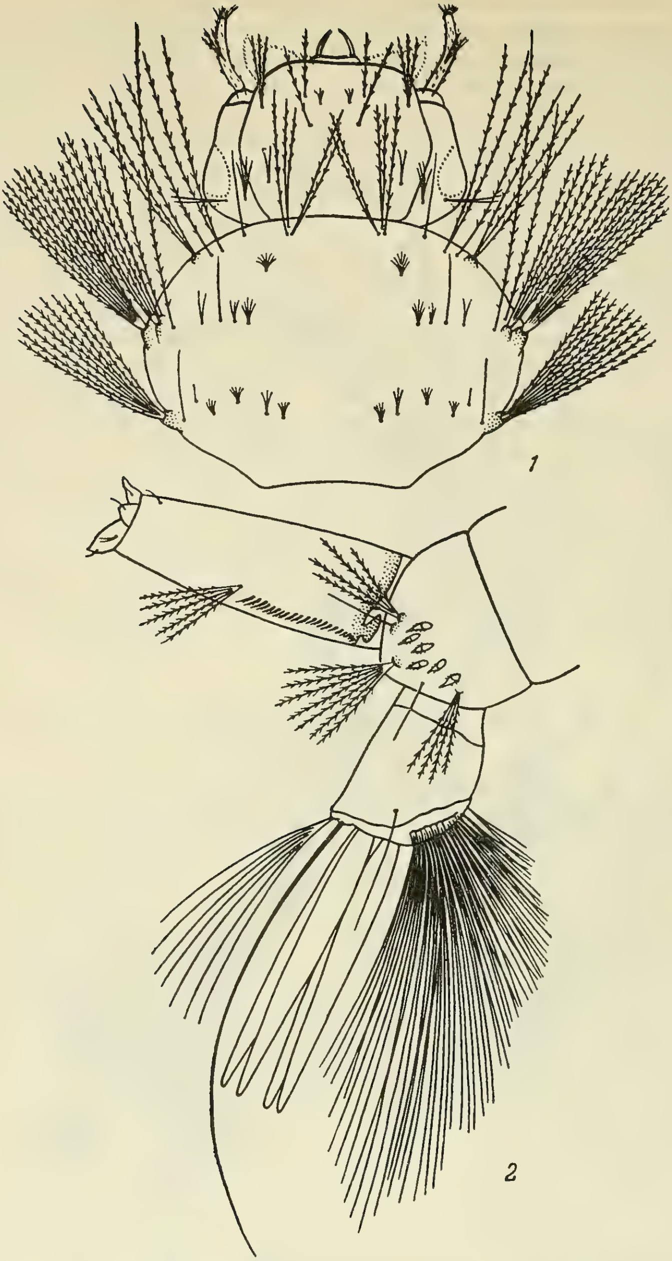

FIGURE 149. Aedes hexodontus Dyar. Fourth-stage larva (after Carpenter and La Casse):

1 – anterior end, dorsal; 2 – posterior end, lateral.

Comb usually with 7 scales (6–9), rarely 10–11), with a distinct main spine and small, thin spines at the base. Siphon (index about 3) straight, tapering. Pecten with 12–17 closely spaced denticles, occupying $\frac{1}{3}$ – $\frac{2}{5}$ of the length of the siphon from the base; the distal denticle is sometimes larger than the others and rarely more widely separated. Hair tuft situated distal to the pecten, with 2–7 (4–5) branches.

Last segment of abdomen with a ring-shaped saddle surrounding it.
243 Outer caudal hairs long, simple, inner hairs with 4–10 (6–8) branches forming a fan; lateral hair simple. Fin with 16–18 tufts on the common base, 2 (rarely 1) shorter tufts before the base. Gills lanceolate, slightly pigmented, usually twice as long as the saddle.

Distribution. The species was until recently confused with other species of the communis group so that its distribution was not clear. In the USSR it occurs to the Kola Peninsula, Karelia in the north (Prionezhskii District), Leningrad area (Petrodvorets) and in the Nenets National District (Nizhnepecherskii District) and in West and East Siberia. It is apparently widely distributed in the subarctic tundra and taiga, and in mountain regions in the south. Northern Sweden (Vockeroth, 1954), Canada, Alaska and mountainous regions of the U. S. A.

Biology. An early spring species; the larvae appear when the snow begins to melt in various types of small water bodies; they occur in the mountains in water with a stony bottom. The adults apparently fly earlier than A. punctor and are vicious bloodsuckers.

20. Aedes (Ochlerotatus) sticticus Meigen, 1838

It differs from the preceding species in the smaller scales on the mesepimera, coloration of mesonotum and tibiae, and in the structure of the hypopygium.

Proboscis, palps and wings with dark scales. Mesonotum with a broad, distinct longitudinal stripe (or with 2 approximate stripes) of dark brown scales. There may also be 2 longitudinal dark lateral stripes. Lateral parts of mesonotum with silvery gray or cream-colored scales. Spot of white scales on mesepimera not reaching their lower margin. Fore and mid-femora dark anteriorly. Light scales forming a longitudinal stripe on
244 the outer surface of the hind tibiae which is sometimes indistinct. Abdomen dorsally with black scales with a bronze sheen and with white, triangular spots on the sides connected by transverse stripes at the base of the segments; stripes narrower in the middle, sometimes interrupted.

Hypopygium (Figure 150) resembling that of A. punctor, but differing in the form of the basal lobe of the coxite and wing of the claspette: basal lobe separated from the coxite in the distal part; wing of claspette with a small, transparent widening, wing short, about twice longer than wide.

Fourth-stage larva (Figure 151) large, brown, with lighter head and siphon. Frontal hairs secondarily feathered: outer hairs usually with 5 branches, median hairs situated before the inner, both pairs with 2–3 branches, rarely more; one of the hairs may be rarely simple. Postclypeal hairs situated between the median hairs, short, with 1–4 branches. Antenna short, 0.4–0.5 times as long as the head, with sparse spines; hair tuft with 4–5 short branches, situated in the middle, slightly basal to it.

(243)

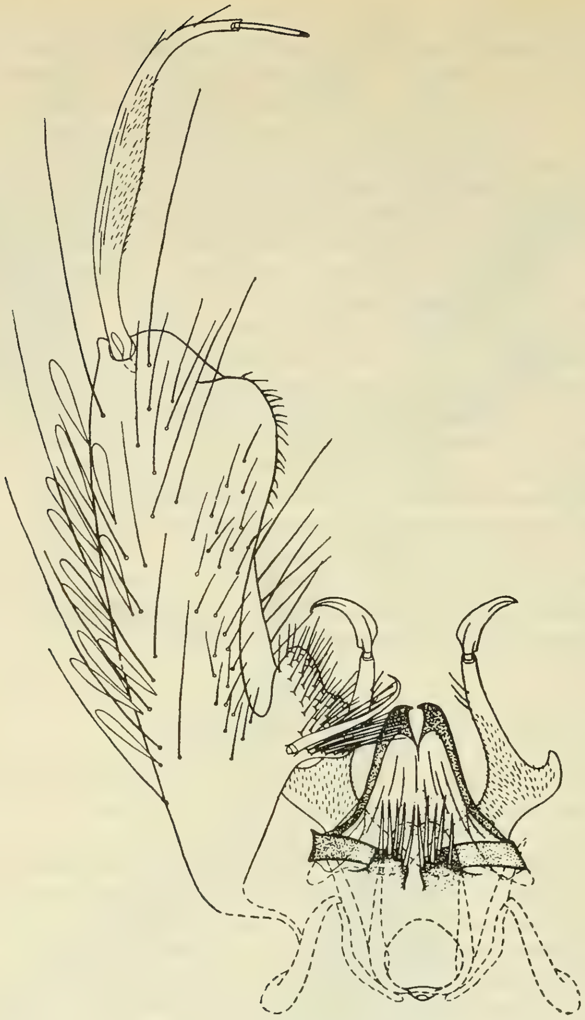

FIGURE 150. Hypopygium of Aedes sticticus Mg. (after Carpenter and La Casse)

Comb on 8th abdominal segment with 16–27 (usually 20–24) scales in 2–3 irregular rows, scales with a moderately large main spine and a few shorter spines at the sides of the base, spines near the main spine nearly as large as this. Siphon relatively short, straight (index 2–2.5, rarely 3.0), tapering from the basal third. Pecten extending beyond the middle, usually with 20–25 equally spaced denticles, the distal denticle sometimes slightly more widely separated than the others. Hair tuft situated beyond the middle, with 5–6 secondarily feathered branches, as long as the width of the siphon at the base.

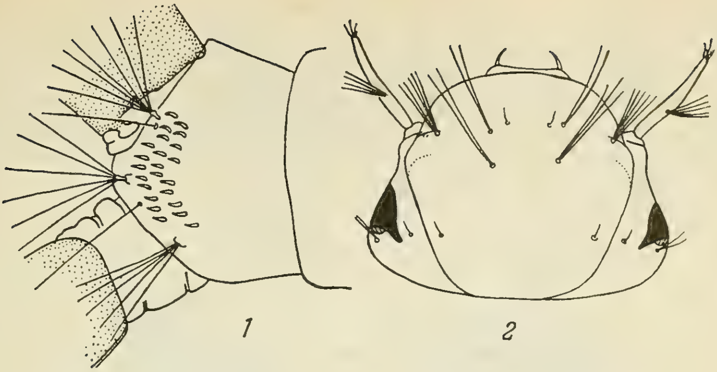

FIGURE 151. Aedes sticticus Mg. Fourth-stage larva (after Peus): 1 — 8th abdominal segment, lateral; 2 — head, dorsal.

Saddle of last segment extending to middle of sides or to its lower margin; lateral hair short, simple; outer caudal hairs simple, much longer than the siphon; inner hairs with 6—7 branches. Fin with about 20 tufts on the common base and 1—2 tufts before it. Gills longer than the saddle, pointed, not pigmented.

Distribution. In Europe to Finland and Karelia in the north, to Yugoslavia, the southern Ukraine and Northern Caucasus in the south; Siberia, Transbaikalia, Khabarovsk Territory, Maritime Territory; Japan, North America.

Biology. The larvae occur in water bodies formed by snowmelt or flooded rivers, with partly shaded trees, their bottom covered with fallen
245 leaves, often together with larvae of A. vexans. Hibernation in the egg stage. The eggs may remain viable for 2—3 years in the soil. Characteristic for the zone of mixed forests and forest-steppe. The records of A. sticticus from the northern taiga and tundra are probably not correct. In some places (Western Ukraine, Transbaikalia) they bite in large numbers. One generation per year. They appear much later than A. communis and A. punctor. This is more a summer than a spring species.

21. Aedes (Ochlerotatus) nigrinus Eckstein, 1918

Closely related to A. sticticus, but differing from it in details of coloration of the antennae, legs and wings (Peus, 1933).

First segment of flagellum of antennae thick, black (not thick, yellow at the base in A. sticticus). Base of costa, subcosta and base of media with white scales. Fore and mid-femora variegated anteriorly. Light stripes on the abdomen not narrowing in the middle or narrowing only slightly.

Hypopygium: basal lobe of coxite shorter and wider than in A. sticticus, its outer margin uniformly convex; wing of claspette with a small, plate-shaped widening, twice as long as wide.

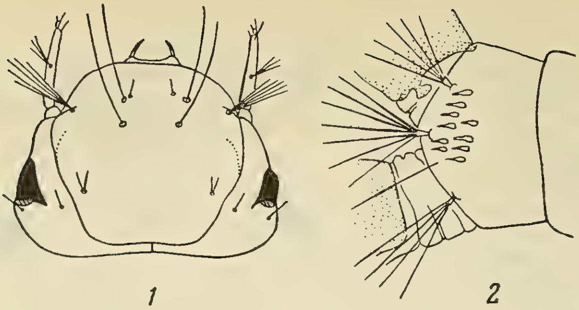

FIGURE 152. Aedes nigrinus Eck. Fourth-stage larva (after Peus): 1 – head, dorsal; 2 – 8th abdominal segment, lateral.

Fourth-stage larva (Figure 152) resembling that of A. sticticus. Frontal hairs slightly secondarily feathered, outer hairs with 5 branches, median hairs situated before the inner, both pairs simple, rarely one hair 2-branched; postclypeal hairs short, with few branches. Antenna slightly less than half as long as the head, with sparse spines, hair tuft with 3–5 short branches situated at $^2/_5$ of the length of the antenna from the base.

Comb usually with 10–12 (rarely 15–17) scales, which are more elongate and have a longer main spine than in A. sticticus. Siphon short, straight, slightly tapering (index 2.0 or slightly more). Pecten nearly reaching middle of siphon, usually with 17 denticles and several rudimentary denticles at the base. Tuft with 4–6 branches situated in the middle or slightly beyond it.

Saddle of last segment extending nearly to the lower margin of the sides; lateral and caudal hairs as in A. sticticus. Fin usually with 13–14 tufts on the common base and 3–4 tufts before the base. Gills of varying length, sometimes as long as the siphon. The upper pair is longer than the lower in specimens with shorter gills; the two pairs are of the same length in specimens with long gills.

Distribution. Europe: West and East Germany, Denmark, southern Scandinavia, Finland, Czechoslovakia. Also found in some parts of the European USSR: Estonia, Leningrad and Vologda regions, Northern Urals, West Siberia. A rare species which inhabits mainly open meadows.

246 Biology. The larvae occur in open pools on meadows with rich vegetation, formed by snowmelt or flooding. Hibernation in the egg stage. Records of several generations in a summer need confirmation.

22. Aedes (Ochlerotatus) hungaricus Mihályi, 1955

This is a recently described species and its systematic position is not quite clear.

Small mosquitoes. Proboscis and palps of females with dark scales. Mesonotum with whitish gray scales and a distinct, dark brown longitudinal stripe, which is divided into two stripes in the posterior half. Spot of light scales nearly reaching the anterior margin on the mesepisterna and not reaching the lower margin on the mesepimera as in *A. sticticus* and *A. nigrinus*. Hypostigmal and postcoxal spots absent. Tarsi dark, without light stripe on the outer side of the hind tibiae. Wings with dark scales, which are especially dense on the costa and r_1. Abdomen with dark scales dorsally and light stripes at the base of the tergites which are slightly narrower in the middle; spots of white scales at sides of tergites.

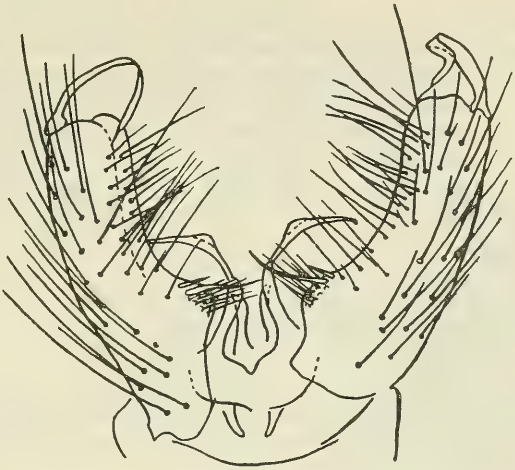

FIGURE 153. Hypopygium of *Aedes hungaricus* Mih. (after Mihályi)

Hypopygium (Figure 153): coxite narrow, with dense hairs; ends of hairs of left and right coxite slightly overlapping. Basal lobe of coxite moderately convex, with 2 strong setae, one long and curved, the other thinner, short and straight. Apical lobe weakly developed. Claspettes with nearly straight stem and long wing which is distinctly wider in the middle; the narrow basal part of the wing ("manubrium") is distinct. Phallosome short, ovoid. Appendages of tergite 9 with 3–4 long, curved setae.

Fourth-stage larva yellowish-brown, with darker head and light spots at points of attachment of muscles. Frontal hairs: outer hairs with 6–8, median hairs with 2 branches, inner hairs simple, situated behind the median hairs, all hairs slightly secondarily feathered. Postclypeal hairs indistinct between the median frontal hairs. Antennae slightly more than half as long as the head, with sparse spines, hair tuft with 8–10 branches, situated at $^{1}/_{3}$ of the length of the antenna from the base.

Comb on 8th abdominal segment with 16–24 (average 20) scales with a long, pointed main spine and shorter spines at the base; the marginal spines near the main spine may be as long as this. Siphon cylindrical,
247 widest at a third from the base; index 2.0–2.4 (average 2.2); pecten with 19–24 (average 20) closely spaced denticles which are longer distally and extend beyond the middle of the siphon, each denticle in the form of a thin, slightly curved spine with several accessory denticles at the base; tuft

with 3–5 branches with slight secondary feathering, situated beyond the middle of the siphon, distinctly separated from the distal denticle.

Saddle of last segment covering the sides to the middle, lateral hair simple, half as long as the saddle; outer caudal hairs simple, inner hairs forming a fan with about 10 branches. Fin with 15 tufts on the common base and 3, rarely 4 (young larvae), shorter tufts before the base. Gills lanceolate, not pigmented, upper pair longer than the lower, distinctly longer than the saddle.

Distribution. Hungary, Danube valley (Mihályi and Gulyas, 1963). Apparently characteristic for floodplains. Not found in the USSR.

Note on systematics. A. hungaricus resembles the other species of the communis group in coloration, particularly A. sticticus and A. nigrinus, but differs from them in the absence of a light stripe on the outer side of the hind tibiae; the structure of the hypopygium, the presence of two strong setae on the basal lobe of the coxite and the weak development of the apical lobe are more characteristic for the species of the caspius group.

23. Aedes (Ochlerotatus) diantaeus Howard, Dyar and Knab, 1917

They are usually slightly larger than specimens of the communis group. Fresh specimens are distinguished by the steel sheen of the black scales on the proboscis, legs and abdomen.

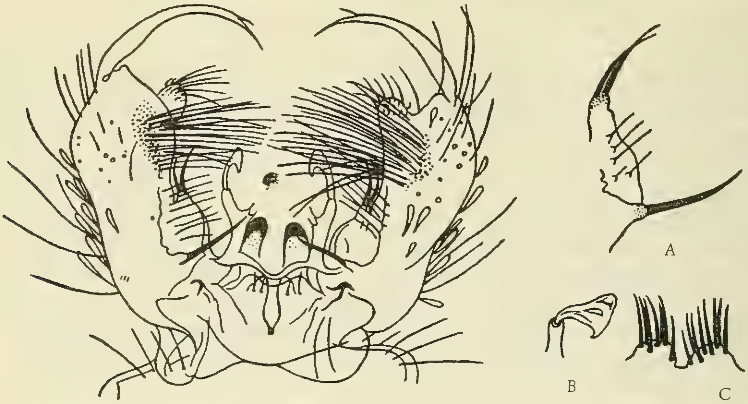

FIGURE 154. Hypopygium of Aedes diantaeus H.D.K. (after Natvig):

A — basal lobe of coxite; B — wing of claspette; C — lobes of tergite 9. High magnification.

Proboscis and palps with black scales. Mesonotum with golden or silvery gray scales, with a broad longitudinal dark stripe or 2 approximate stripes. Spot of white scales on the mesepisterna not extending to their

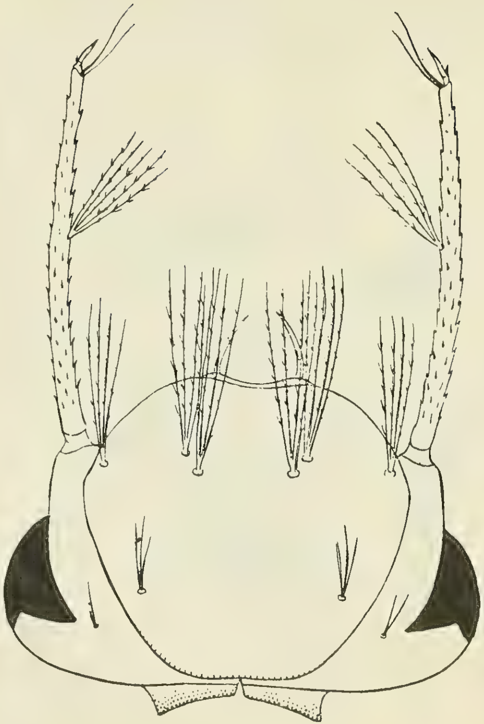

FIGURE 155. Aedes diantaeus H.D.K. Fourth-stage larva. Head, dorsal.

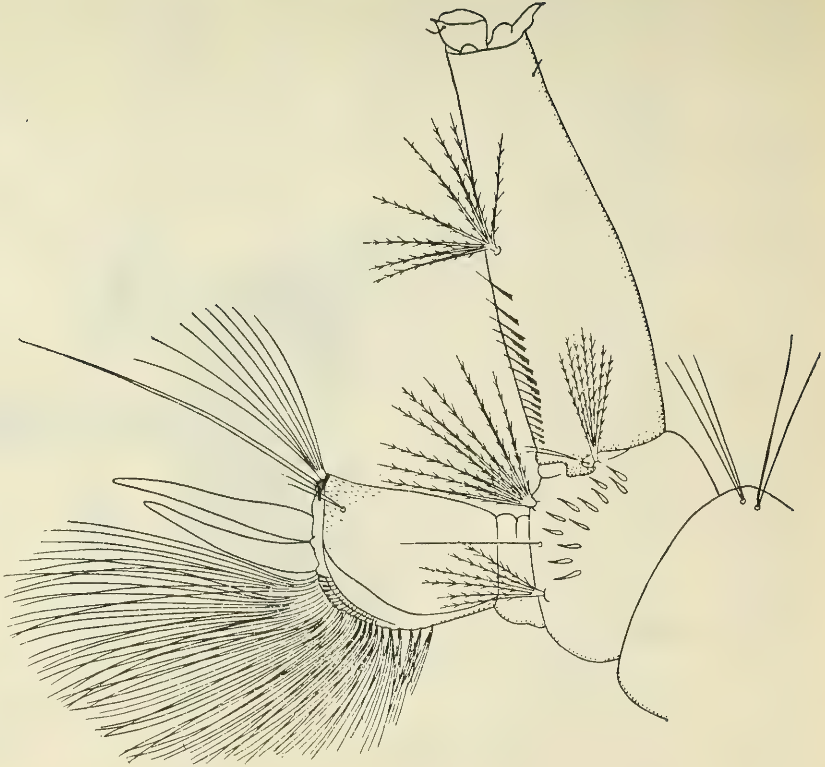

FIGURE 156. Aedes diantaeus H.D.K. Fourth-stage larva. Posterior end, lateral.

anterior margin (a difference from all preceding species of the communis group). Postcoxal and hypostigmal scales absent. Wings, tibiae and tarsi 249 with dark scales. Abdomen with black scales dorsally and triangular, white spots at the sides, sometimes connected by narrow stripes at the anterior margin.

Hypopygium very characteristic (Figure 154). Inner surface of coxite with a large, dense tuft of hairs directed inward. Basal lobe with 3 spines, two of them close together on a tubercle. Claspettes with angularly bent stem and broad wing.

Fourth-stage larva (Figures 155–157) large, light to dark brown; the very long antennae distinguish the larvae of this species and are visible with the naked eye.

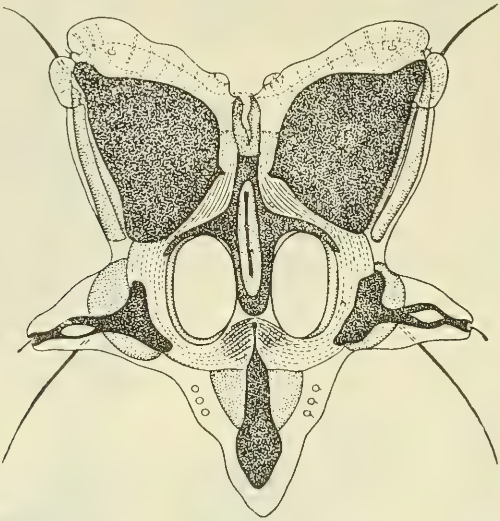

FIGURE 157. Aedes diantaeus H.D.K. Fourth-stage larva. Stigmal plate.

Frontal hairs secondarily feathered, long: outer hairs with 3–6 (usually 4) branches, median hairs with 2–5 (usually 3–4) branches, situated before inner hairs with 2–6 (usually 3–4) branches; postclypeal hairs situated between the median hairs, short, very thin. Antennae 1.1–1.3 times as long as the head, nearly straight, thin, with distinct spines and a tuft with 3–7 (usually 4–5) secondarily feathered branches situated near the middle.

Comb of 8th abdominal segment with 6–13 (11–12) large scales in 2 irregular rows, scales with a long, pointed main spine and short, thin spines at the sides of the base. Siphon straight, tapering from the basal third; pecten with 15–22 (usually 16–18) long, spinelike denticles, which are shorter toward the base and with 1–2 distal, more widely spaced denticles; tuft situated in the middle, slightly basal to it, with 6–10 (usually 7–8) slightly secondarily feathered branches, as long as the width of the siphon at the base.

Saddle extending to lower margin of sides of last segment; lateral hair simple, shorter than the saddle; outer caudal hairs longer than the siphon, simple, inner hairs nearly half as long, with 10–13 branches. Fin with 21–22 tufts on the common base and 2–4 tufts before the base. Gills narrow, lanceolate, slightly longer than the saddle.

Distribution. Western Europe to the Maritime and Khabarovsk territories and from Norway and Karelia in the north to the Southern Ukraine and Northern Caucasus. It also occurs in part of North America.

Biology. The larvae develop in different types of temporary water
bodies in forests, formed by snowmelt. In pits, ditches, puddles, etc.,
shaded or in open localities, with cold water. Hibernation in the egg stage;
usually one generation per year. A late spring species with delayed larval
development; it is characteristic for mixed forests but also occurs in the
250 taiga; often in thinned forests in glades and at the edges. Flight at the end
of spring, later than many other species of Aedes. They are active blood-
suckers but usually appear in small or moderate numbers. They are the
predominant species in some parts of the Carpathians.

24. Aedes (Ochlerotatus) intrudens Dyar, 1919

The species differs from the preceding species in the presence of a hypostigmal spot, i. e. a few scales situated below the anterior spiracle. Proboscis, wings, legs and abdomen covered with dark scales without a steel sheen as in A. diantaeus.

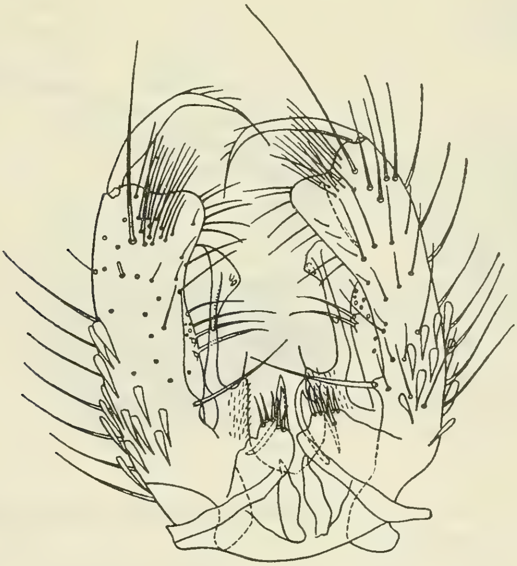

FIGURE 158. Hypopygium of Aedes intrudens Dyar

Proboscis and palps with brown scales and with grayish white scales scattered on the palps. Mesonotum with golden bronze scales, lighter (whitish) scales at the lateral margin, sometimes with an indistinct longitudinal dark stripe or with two narrow stripes. Postcoxal spot absent, hypostigmal spot present. Scales on mesepimera not reaching lower margin of sclerite. Fore femora with dark scales, with more or less white scales, mainly anteriorly. Tarsi dark. Wings with dark scales, sometimes a few light scales at the base of the costa. Abdomen dark dorsally, with white stripes at the base of the segments; stripes of uniform width, rarely narrower in the middle.

(251)

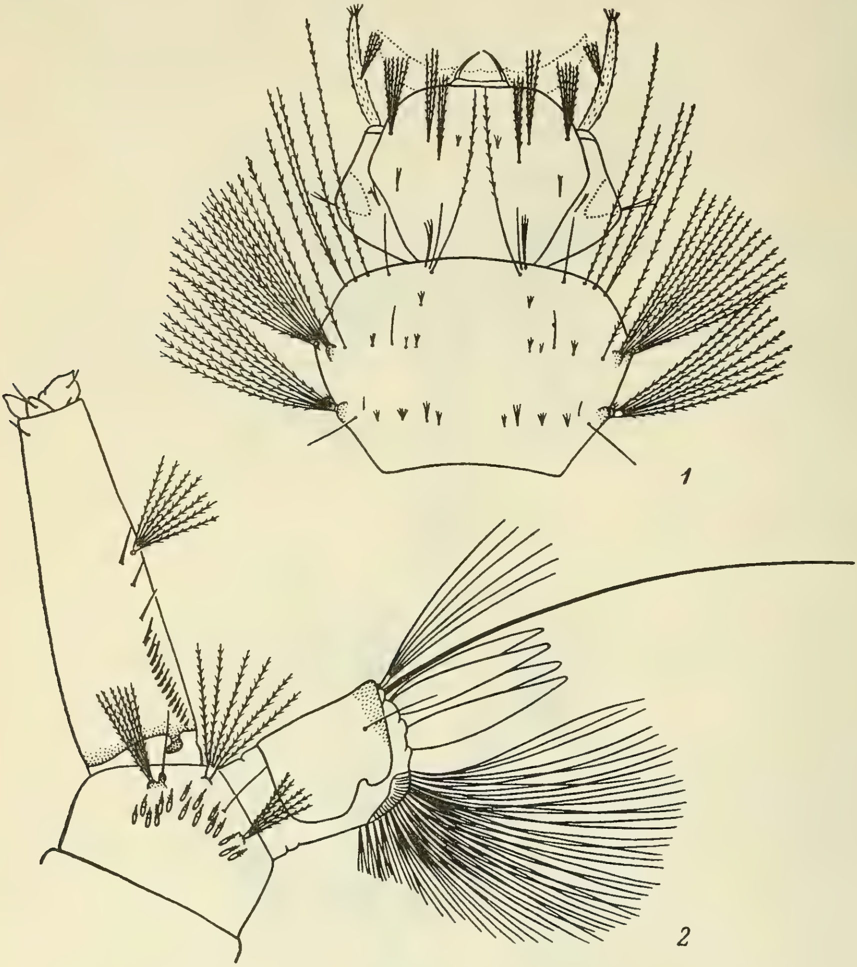

FIGURE 159. Aedes intrudens Dyar. Fourth-stage larva (after Carpenter and La Casse): 1 — head, dorsal; 2 — posterior end, lateral.

Hypopygium (Figure 158) as in the preceding species, with 3 spines on the basal lobe and a dense tuft of hairs on the inner surface of the coxite. This tuft is smaller than in A. diantaeus and situated more distally, on the apical lobe, the hairs directed inward and posteriorly. Stem of claspette with a finger-shaped process in the middle, with a hair at the apex.

Fourth-stage larva (Figure 159) medium-sized to large, yellowish brown to dark brown. Frontal hairs secondarily feathered: outer hairs with 5–9 (usually 6–7) branches, median hairs with 3–4 (usually 3) branches, situated before the inner hairs with 3–5 (usually 4) branches; postclypeal hairs situated between the median hairs, short, with a few, thin branches. Antenna slightly more than half as long as the head, with sparse spines, hair tuft with 6–8 branches situated in the middle, slightly basal to it.

Comb with 10–18 (usually 12–16) scales in two irregular rows, scales
251 large, dark, with a long, pointed main spine and short, thin spines at the sides of the base. Siphon straight, distinctly tapering from the middle, index 2.8–3.5 (average about 3.0). Pecten with 14–22 (usually 18–19) denticles which are longer distally, 1–4 (usually 2–3) more widely spaced and forming larger, smooth spines while the others have 1–2 accessory denticles near the base; the most distal spine is situated distinctly beyond the middle of the siphon. Hair tuft with 4–10 (average 7–8) thin branches with weak secondary feathering, as long as the width of the siphon at its position. Hair tuft situated in the middle or distal to it; if there are 1–2 widely spaced denticles, the tuft is situated distal to them, if there are more widely spaced denticles, the tuft is situated between them.

Saddle of last segment extending to middle or lower margin of sides, of irregular form; lateral hair simple, short; outer caudal hairs simple,
252 distinctly longer than the siphon; inner hairs usually with 6–8 branches, about $^2/_3$ as long as the siphon. Fin with 16–18 tufts on the common base and 1–3 shorter tufts before the base; the branching of the tufts, especially of the largest, posterior tufts of the fin, begins far from the base, and the stem is distinctly longer than the lateral processes of the base. Gills longer than the saddle, markedly varying in length, pointed, not pigmented.

Distribution. Western Europe to the Khabarovsk Territory and Kamchatka. Extending in the north to the forest-tundra, but apparently not to the tundra. It occurs in the steppes of the Ukraine. Northern and Central Europe, northern part of the U.S.A. and southern Canada.

Biology. The larvae occur in shallow pools and swamps in forests formed by snowmelt or filtration during rise of the groundwater. They live in water without vegetation with a bottom covered with fallen leaves and are found together with larvae of A. excrucians, A. cataphylla, A. communis, A. diantaeus and A. cinereus. The females attack man in large numbers mainly in forests, primarily alder forests. This is a forest species. It has one generation in spring which appears earlier than most other species. Their numbers decrease sharply in summer.

25. Aedes (Ochlerotatus) pullatus Coquillett, 1904

Closely related to A. intrudens, differing in details of coloration and in the structure of the hypopygium.

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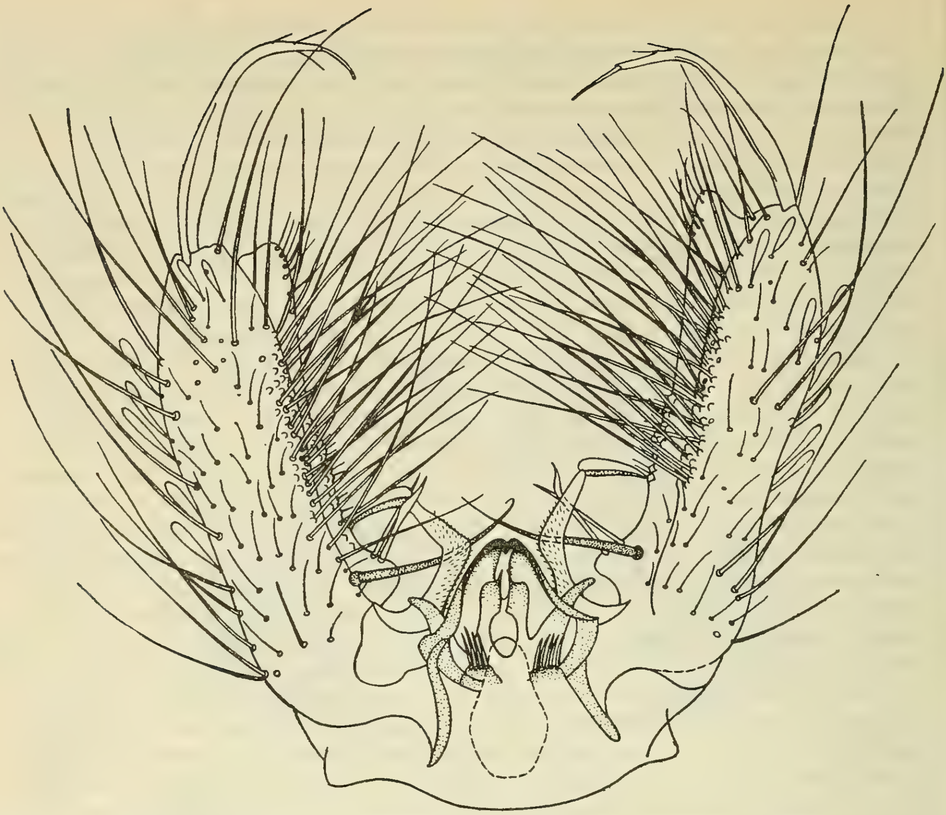

FIGURE 160. Hypopygium of Aedes pullatus Coq.

Proboscis and palps with dark scales, sometimes with some light scales on the palps. Mesonotum with golden or whitish scales, with 2 dark narrow longitudinal stripes, with dark brown scales or without scales. Integument of mesonotum usually black. Hypostigmal spot present, postcoxal scales absent. Scales on mesepimera extending to lower margin of sclerite. Lower mesepimeral setae present (1–5). Legs: fore femora dark anteriorly, tarsi with brown scales. Wing with dark scales, a few light scales at the base. Abdomen with dark scales dorsally, with light stripes at the base of the tergites, stripes sometimes narrower in the middle.

Hypopygium (Figure 160): coxite with long, dense hairs, with 3 spines at the base as in the preceding two species, but a tuft of dense hairs on the coxite is absent; one of the two spines flattened, forming a narrow plate, sometimes with 2 delicate small branches at the end; stem of claspette angularly bent, without finger-shaped process.

Fourth-stage larva (Figures 161 and 162) medium-sized, light brown or darker. Frontal hairs strongly branched, secondarily feathered; outer hairs with 8–13, median hairs with 3–8 (average 6), inner hairs with 3–7 (average 5) branches; postclypeal hairs short, thin, with 4–5 branches. Antennae short, only slightly more than half as long as the head, with spines and a tuft with 5 secondarily feathered branches in the middle.

(253)

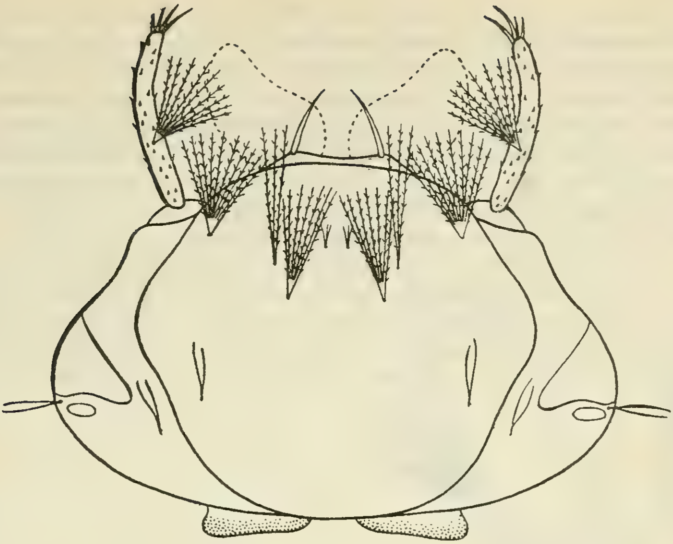

FIGURE 161. *Aedes pullatus* Coq. Fourth-stage larva. Head, dorsal (after Carpenter and La Casse).

Comb with 50–60 scales of varying form: a main spine may be absent and there may be spines at the margin which are shorter at the base, or the main spine is more or less distinct with shorter lateral spines. Siphon uniformly tapering from the basal third; index 3.0–3.5. Pecten with 15–25 254 closely spaced denticles which are longer distally, and 2–3 rudimentary denticles, not reaching the middle of the siphon; hair tuft situated in the middle, distinctly beyond the distal denticle, with 5–8 secondarily feathered branches, longer than the width of the siphon at the position of the tuft.

Saddle of last segment covering more than half of the sides; lateral hair simple, slightly more than half as long as the saddle; outer caudal hairs simple, long, inner hairs forming a symmetrical fan with 6–10 smooth branches. Fin usually with 15 tufts on the common base and 1–3 shorter tufts before the base. Gills pigmented, lanceolate, slightly curved; upper pair slightly longer than lower pair, 1.5–2 times as long as the saddle or longer, sometimes as long as the siphon.

Distribution. The distribution is disjunct. In Europe and the south of the USSR, it occurs in the mountains, outside mountain areas in the north. Pyrenees, Alps, Black Forest, Harz, Tatra, Carpathians, Caucasus, mountains of Tien Shan, southeast Kazakhstan, Leningrad, Moscow and Saratov regions, Kola Peninsula, Tuva region, Transbaikalia, Maritime Territory. The collections at the Zoological Institute contain specimens of *A. pullatus* with the label: western foothills of Otkhon-Tengri, 2,300 m, Kozlov, July 1924. Widespread also in North America: Alaska, Canada, U.S.A., Rocky Mountains to altitudes of 3,000–4,000 m.

255 Biology. The species occurs in the north in lowlands and plains: it is restricted to mountains of 2,000 m and higher in the south. The larvae occur in different types of small water bodies in spring, shaded (in the south)

or open (in the north and in mountains), without vegetation. The species occurs in the mountains in small lakes with sandy or rocky bottom. In the Khibiny Mountains it occurs in turf waters and marshes along rivers with silt or stony bottom or with a bottom covered with fallen leaves of dwarf birch. One generation per year from hibernating eggs, later than in other species of Aedes; mainly a summer species. They are usually found in small numbers, but they appear in large numbers on the Kola Peninsula and in the Khibiny Mountains (Fridolin, 1936).

(254)

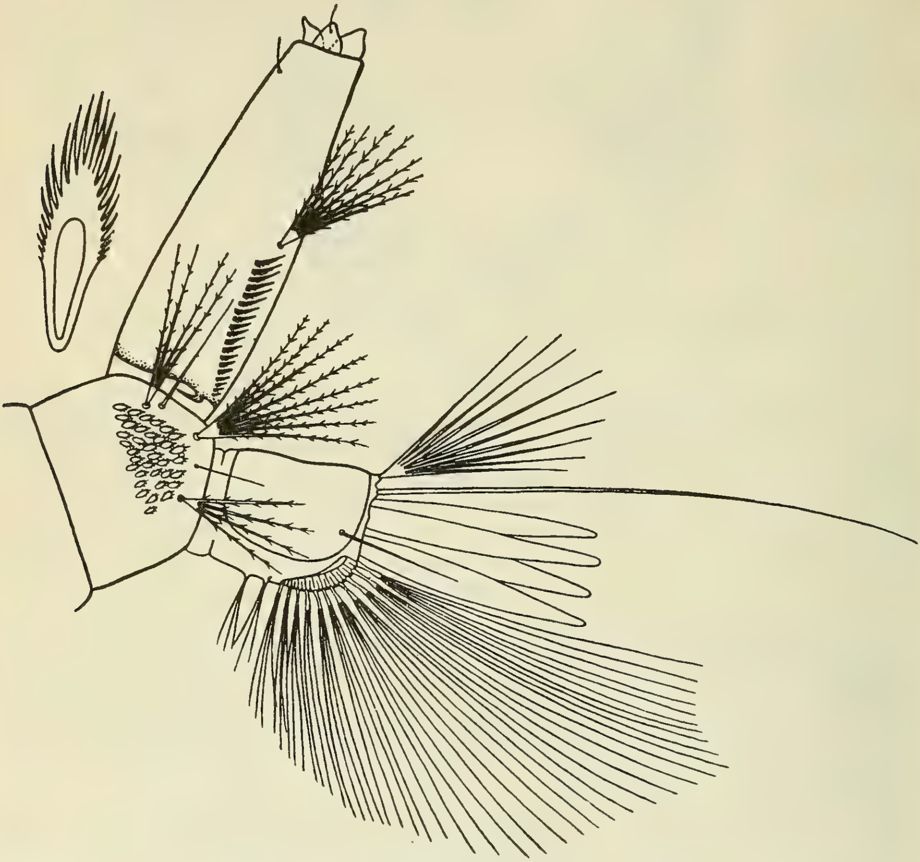

FIGURE 162. Aedes pullatus Coq. Fourth-stage larva. Posterior end, lateral (after Carpenter and La Casse).

26. Aedes (Ochlerotatus) nigripes Zetterstedt, 1838 (alpinus Edwards, 1921)

Dark, medium-sized mosquitoes. The species differs from the other species of the communis group, except A. impiger, in the hairs on the thorax and in the position of the proepimeral setae.

Proboscis and palps with dark brown scales. Palps of male distinctly shorter than the proboscis, terminal segment of palps not thickened. Mesonotum densely covered with long, brownish black setae. Integument of mesonotum black, scales brown or reddish brown, with a golden sheen laterally. Pleurae of thorax with creamy white scales. Postcoxal spot present, hypostigmal spot absent. Setae on proepimera irregularly scattered in the posterior half and at the dorsal margin. Scales on mesepisterna extending to anterior margin of sclerite. Femora variegated anteriorly with white and brown scales, sometimes mainly dark, with a few light scales. Claws long, slightly curved, with a short denticle which is less than half as long as the claw. Wings with dark scales, light scales present only at the base. Abdomen with dark scales dorsally (often with a slight reddish tone), with white stripes at the base of the tergites; stripes, especially on the posterior segments, sometimes indistinct, with diffuse margin.

(256)

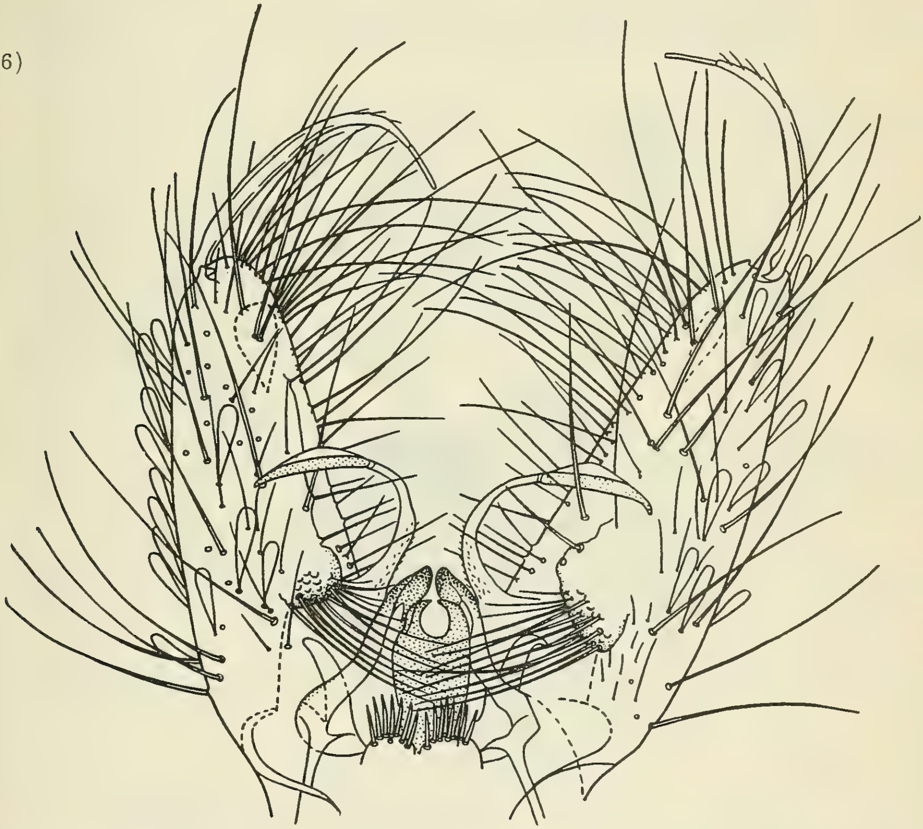

FIGURE 163. Hypopygium of Aedes nigripes Zett.

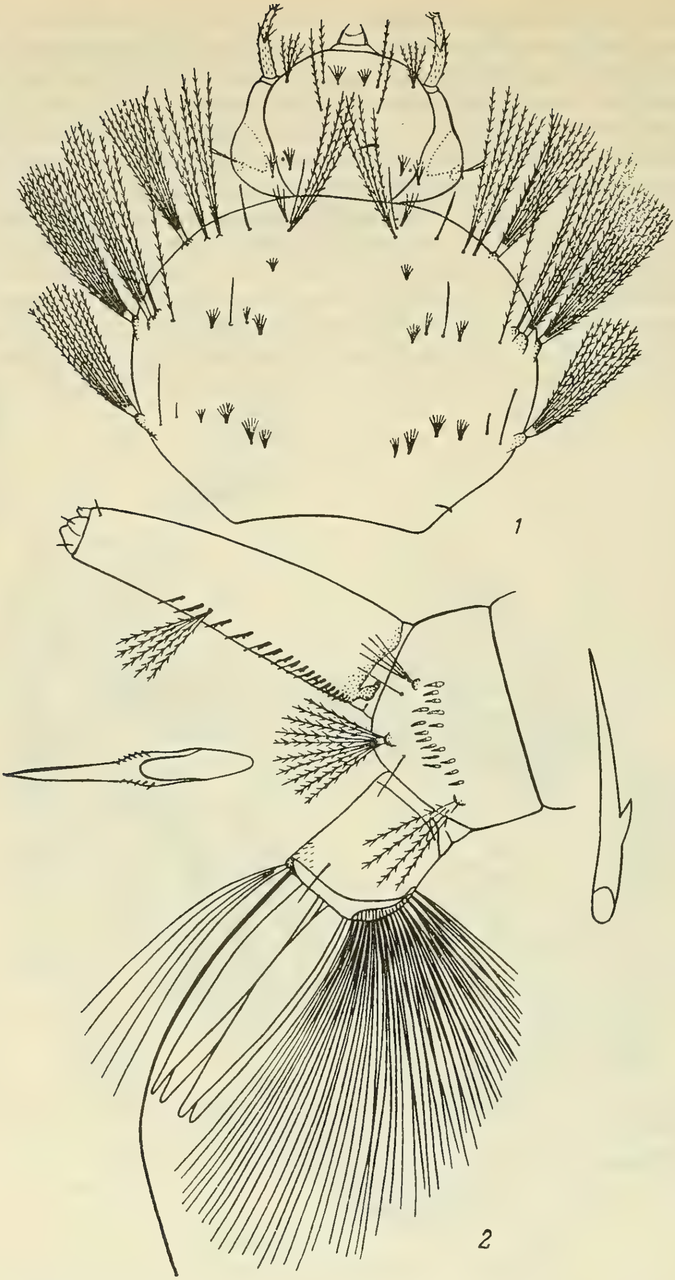

FIGURE 164. *Aedes nigripes* Zett. Fourth-stage larva (after Carpenter and La Casse):

1 – anterior end, dorsal; 2 – posterior end, lateral.

Hypopygium (Figure 163): coxite with dense, long hairs; ends of hairs of left and right coxite usually slightly overlapping. Apical lobe of coxite weakly developed; basal lobe with setae but without distinct spine or a distinct strong seta; marginal seta usually larger than the others. Stem of claspette curved, rarely straight. Wing of claspette with weakly marked plate-shaped widening in the middle third. Processes of tergite 9 large, with 14–20 large, short setae. Phallosome strongly sclerotized, dark, bifurcate.

Fourth-stage larva (Figure 164) medium-sized to large, dark or yellowish brown, with moderately broad head. Frontal hairs with slight secondary feathering; outer hairs usually with 5 branches, median hairs and inner hairs situated behind them, simple; postclypeal hairs with 3–5 thin, short branches. Antennae short, less than half as long as the head; hair tuft with 1–3 short branches situated nearer to the apex. Mouth parts of the mixed type, substrate feeding predominating.

Comb with 10–20 pointed scales, with very small spines at the base. Siphon (index 2.5–3) straight, slightly tapering. Pecten with 12–17 denticles,
256 the 1–4 distal denticles in the form of longer, widely spaced, smooth spines. Hair tuft with 2–6 thin, short branches about as long as the width of the siphon at the base.

Last segment with ring-shaped saddle surrounding it completely or with a narrow slit in the middle of the ventral side. Outer caudal hairs long, simple, inner hairs usually with 5–6 branches; lateral hair with 1–2 branches. Fin with 16–18 tufts on the common base. Gills 1.5–2.5 times as long as the saddle, lanceolate, both pairs of the same length.

Distribution. A circumpolar species characteristic for the tundra. Alaska, Canada (including Arctic islands), Greenland, northern part of Scandinavia and Finland. In the USSR, it occurs on the Kola Peninsula, in the Arkhangelsk Region, Nenets National District, Kara River basin, Noril'sk, Obdorsk, Srednekolymsk, Khatanga basin, mouth of the Lena, Kamchatka and the Komandorski Islands.

Biology. An early spring species developing in pools and other temporary water bodies formed by snowmelt, in the tundra in marshes overgrown with grass and with dwarf willow and birch. They are mass bloodsuckers in some parts of the tundra. Their ecology was studied on Ellesmere Island (west of Greenland) at 81°49' N (Corbet, 1965). The larvae appeared in early June in water bodies formed by thawing snow.
258 Flight begins in 3–4 weeks. The mosquitoes feed at first on the nectar of flowers, particularly Dryas integrifolia. Copulation takes place during swarming. The females may suck blood on the second day after taking flight. Autogenous deposition of eggs has been observed. The eggs are deposited at the edge of the water, 5–10 cm above the surface.

27. Aedes (Ochlerotatus) impiger Walker, 1848
(nearcticus Dyar, 1919; parvulus Edwards, 1921)

A. nearcticus Dyar and A. parvulus Edw. were considered as different species in the past, distinguished mainly by the structure of the hypopygium, the presence (A. nearcticus) or absence (A. parvulus) of a spine on the basal lobe of the coxite. However, this character varies markedly. In some specimens the basal lobe bears a few, nearly equal setae, in others one seta is slightly larger than the others and in still others there is a spine which differs distinctly from the thinner setae. A. nearcticus and A. parvulus should therefore be considered as the same species (Natvig, 1948) and both names are synonyms of A. impiger Walk. A study of the types of Culex impiger Walk. and Aedes nearcticus Dyar showed that they are identical (Vockeroth, 1952).

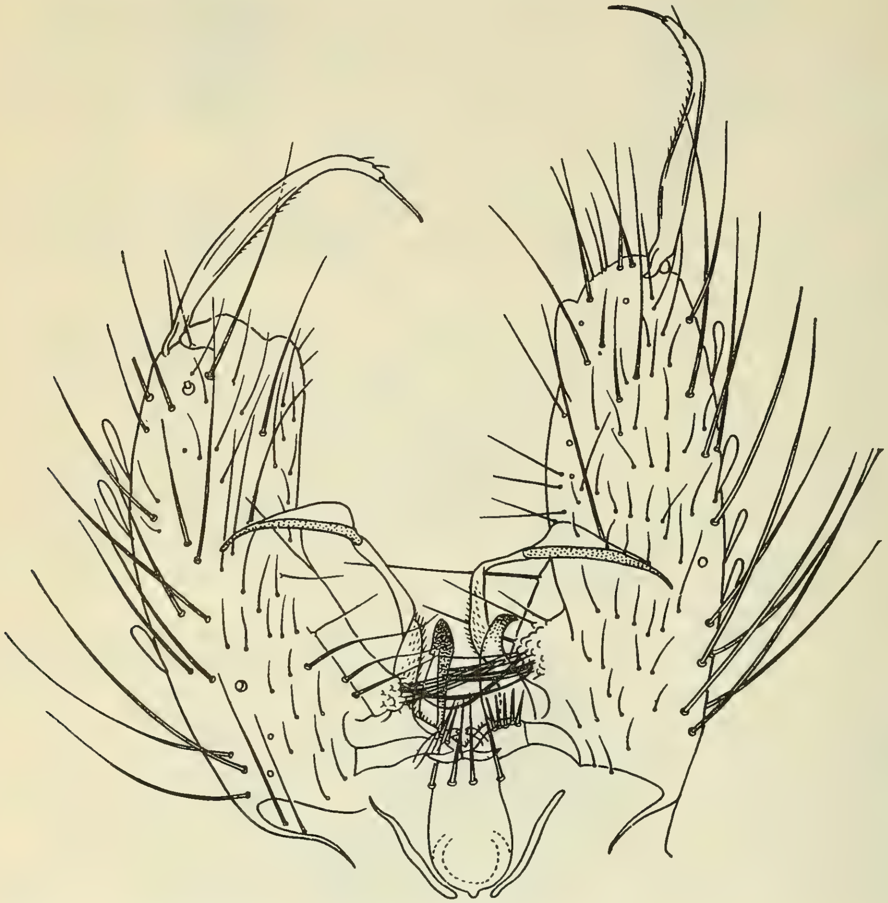

FIGURE 165. Hypopygium of Aedes impiger Walk.

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Aedes impiger, like A. nigripes, differs from the other species of the communis group in the thoracic setae and arrangement of the proepimeral setae. The two species differ in the structure of the hypopygium, the form of the claws, arrangement of the scales on the mesepisterna and in size – A. impiger is smaller.

Proboscis and palps with dark scales. Palps of male as long as or slightly shorter than the proboscis. Mesonotum densely covered with long, black setae. Integument of mesonotum black, scales reddish brown, sometimes with lighter, yellowish brown scales, forming small spots. Setae on the proepimera scattered in posterior half of sclerite. Scales on mesepisterna not reaching their anterior margin. Postcoxal spot present, hypostigmal spot absent.

Femora variegated anteriorly or mainly with dark scales and some light scales. Claws more strongly curved than in A. nigripes, with a long denticle (more than half as long as the claw). Wing with dark scales and with a few light scales at the base. Abdomen dark dorsally, with light stripes at the base of the tergites.

Hypopygium (Figure 165): coxite with moderately long hairs; ends of hairs of left and right coxite usually not overlapping. Apical lobe weakly developed; basal lobe with setae, the marginal seta curved at the end and distinctly thicker and longer. Claspette: stem curved from the middle, wing with distinct plate-shaped widening to the second third. Processes of tergite 9 small, with 4–10 setae. Phallosome weakly sclerotized, with 2 denticles at the end.

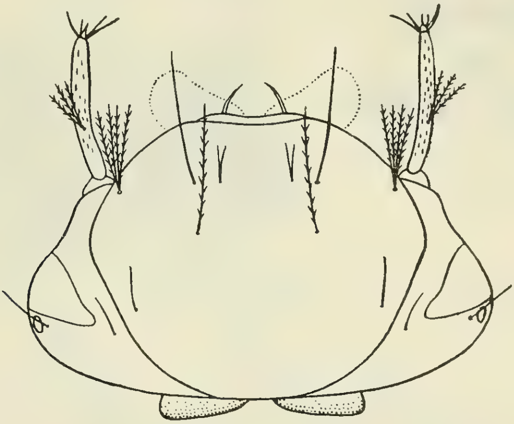

FIGURE 166. Aedes impiger Walk. Fourth-stage larva. Head, dorsal (after Carpenter and La Casse).

Fourth-stage larva (Figures 166 and 167) medium-sized, light to dark brown, with brown head, which is $^1/_4$ wider than long. Frontal hairs: outer hairs with 2–4 secondarily feathered branches, median hairs smooth and simple, inner hairs simple, often secondarily feathered; postclypeal hairs thin, short, with 2–4 branches, situated between the median hairs. Antennae short, less than half as long as the head, with sparse spines; hair tuft with 2–4 secondarily feathered branches situated in the middle, slightly basal to it.

Comb of 8th abdominal segment with 7–16 (average 13–14) scales in 2 irregular rows, scales with a well developed, pointed main spine and small spines at the base. Siphon tapering from the basal third; index about 3.0.

Pecten with 10–20 (average 12–14) closely spaced denticles which are
longer distally and occupy the basal third of the siphon. Hair tuft situated
260 in the middle, slightly basal to it, with 2–6 (average 4) secondarily feathered
branches which are longer than the width of the siphon at its position.

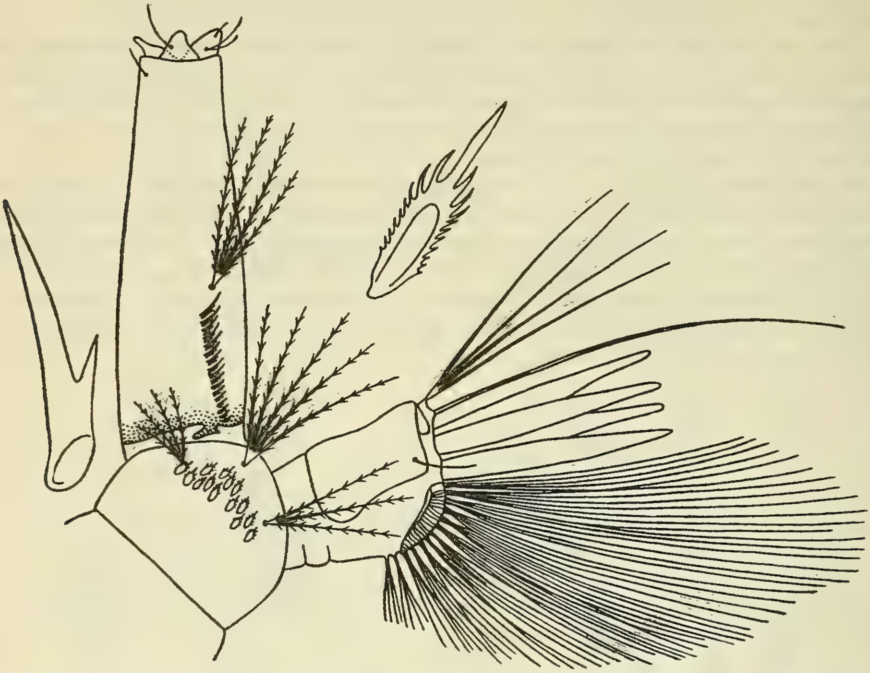

FIGURE 167. *Aedes impiger* Walk. Fourth-stage larva. Posterior end, lateral (after Carpenter and La Casse).

Saddle of last segment extending slightly beyond dorsal half of sides, lateral hair short, simple. Outer caudal hairs simple, long, inner hairs with 3–4 branches. Fin with 14–16 tufts on the common base and 1–3 short tufts before the base. Gills 1.5 times longer than the saddle, lanceolate, pointed, pigmented.

Distribution. Tundra of both hemispheres. The species usually extends further to the north together with *A. nigripes* than other species of mosquitoes. They have been found on Ellesmere Island at 82°30'N, which is the most northern locality where mosquitoes have been found. In the south, the species occurs in the forest zone, mainly in mountain regions. It is distributed in Alaska, Canada, Greenland, northern Scandinavia and Finland. In the USSR, it has been found on the Kola Peninsula, in the Arkhangelsk Region, Nenets National District, Taimyr, mouth of the Kolyma, and the Novosibirskie Islands. It usually occurs together with *A. nigripes*. *A. impiger* predominates in Noril'sk (70°N) (Vol'ftrub, 1963).

Biology. The larvae develop in water bodies formed by snowmelt in the tundra and forest-tundra. They are numerous (lower reaches of the Yenisei) and attack man and animals, especially reindeer. They appear earlier in the spring than the other species.

261 28. Aedes (Ochlerotatus) cataphylla Dyar, 1916
(rostochiensis Martini, 1920)

The species differs from the preceding species of the communis group in the presence of light scales not only at the base but also on other parts of the wing. Also characteristic are the variegated scales on the femora.

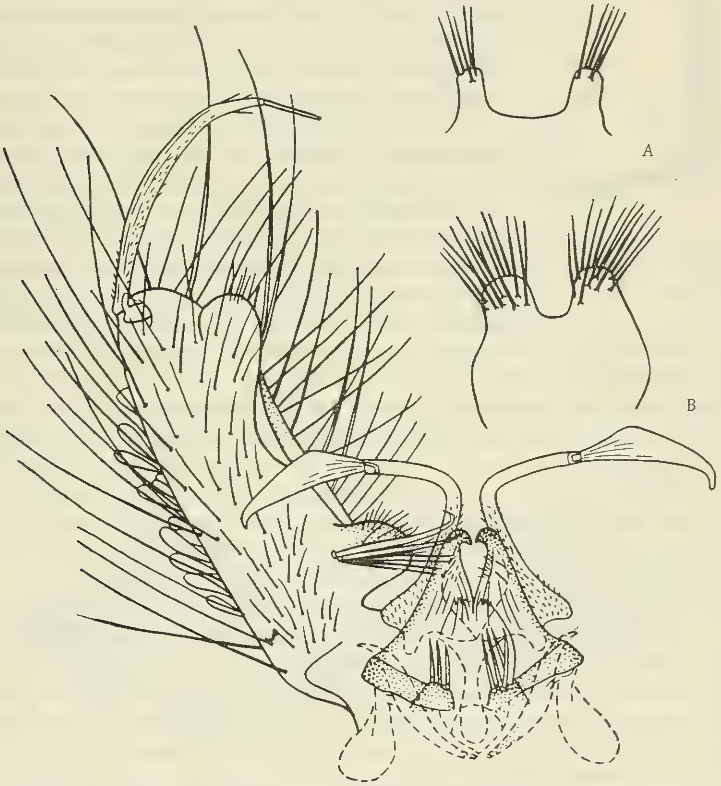

FIGURE 168. Hypopygium of Aedes cataphylla Dyar (after Carpenter and La Casse).

Lobes of tergite 9 of A. cataphylla Dyar (A) and A. leucomelas Mg. (B).

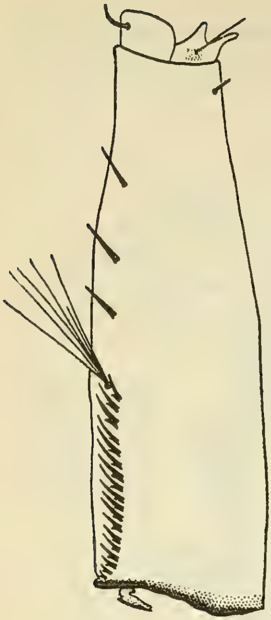

FIGURE 169. Aedes cataphylla Dyar. Fourth-stage larva. Siphon.

Proboscis with uniformly black scales. Palps with dark scales and some light scales. Mesonotum with silvery or light gray scales laterally and with a broad, usually indistinct median stripe of reddish brown or dark brown scales. The entire mesonotum is sometimes covered with chestnut brown scales and with lighter scales at the margin. Postcoxal spot and hypostigmal spot present. The spots are connected by a stripe of scales with a round, white spot on the parastigma, a small sclerite between the anterior spiracle and the anterodorsal margin of the mesepisternum. Femora variegated anteriorly, with white and brown scales. Tibiae and tarsi with dark scales and some light scales. Wings with brown scales with a few whitish scales near the base and a few whitish scales on the costa, subcosta and r_1. Abdomen with blackish brown scales dorsally, broad, white stripes of more or less the same 262 width at the base of the tergites; the last tergites are sometimes covered mainly with light scales.

Hypopygium (Figure 168) with long, thick hairs on the inner surface of the coxites; apex of hairs of left and right coxite overlapping. Basal lobe of coxite small, with one spine or a strong seta. Apical lobe strongly convex. Claspette with sharply curved stem, wing with a plate-shaped widening. Processes of tergite 9 narrow, with 4–13 (usually 6–8) short, strong spines directed posteriorly.

Fourth-stage larva (Figure 169) medium-sized, dark. Frontal hairs: outer hairs with 3–6 secondarily feathered branches, median hairs situated before the inner hairs, both pairs smooth, simple; postclypeal hairs situated between the median hairs, with 2–3 short, thin branches. Antennae less than half as long as the head, straight, with moderately distinct spines and a hair tuft in the middle or slightly more apically, with 3–5 branches, less than half as long as the antennae.

Comb with 10 (rarely) to 28 scales (average 25) in 2–3 irregular rows, scales with a long, pointed main spine and smaller spines near the base. Siphon straight, tapering in apical half (index 2.5–3.0, rarely more); pecten with 11–21 closely spaced denticles and 2–4 larger, smooth pointed spines which are widely separated and extend to $^3/_4$ of the length of the siphon from the base; hair tuft situated in the middle, slightly basal to it, where the pecten ends, with 3–5 branches.

Saddle of last segment extending beyond middle of sides; lateral hair short, simple; outer caudal hairs simple, usually as long as the siphon, inner hairs half as long, with 5–8 branches. Fin with 18 tufts on the common base and 1–2 shorter tufts before the base. Gills pigmented, lanceolate, pointed, of varying length, as long as the saddle or twice as long.

Distribution. Europe, Kazakhstan, Siberia, Far East and part of North America. It extends in the south to the Ukrainian steppe, Northern

Caucasus and Kirghizia (mountains). It occurs in the north in the tundra according to the literature. The northern boundary of distribution needs more exact determination. In Scandinavia it occurs at 64°N, i. e. it does not reach the northern forest boundary (Natvig, 1948). It is found at 65°N in Alaska (Gjullin et al., 1961).

Biology. Hibernation in the egg stage. The larvae occur in puddles formed by snowmelt and spring floods, mainly in open water or at the banks. They are very common in the forest zone and attack in large numbers but they have not been reported as a predominant species. They are more characteristic for open habitats with a thin forest cover. One generation
263 per year. They appear in spring a few days earlier than the other species or together with A. communis and A. punctor. Flight ends in midsummer.

29. Aedes (Ochlerotatus) leucomelas Meigen, 1804
(salinellus Edwards, 1921)

This species is closely related to A. cataphylla in coloration and the structure of the hypopygium, but differs in the presence of light scales on the proboscis and the numerous light scales on the wings.

Proboscis with dark scales,with more or less numerous yellowish brown scales which usually predominate in the middle of the proboscis. Mesonotum with bronze brown scales, without dark longitudinal stripe, scales at the sides lighter, golden or grayish white. Wings with dark scales, with many light scales which are more numerous on the costa, subcosta and radius. Pleurae of thorax and legs as in A. cataphylla. Abdomen with broad white transverse stripes on the tergites, which are usually distinct. Some specimens have diffuse margins of the stripes and isolated light scales in the posterior half of the tergites (sometimes numerous on the posterior tergites). Such specimens resemble A. detritus to some extent.

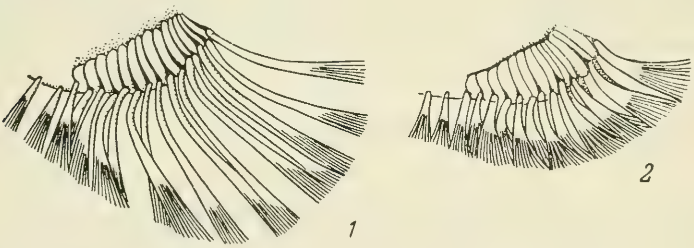

FIGURE 170. Base of tufts of fin of 4th-stage larvae (after Fedorov):

1 – Aedes leucomelas Mg.; 2 – Aedes caspius Pall.

Fourth-stage larva (Figure 170) medium-sized and of varying shades of brown. Frontal hairs secondarily feathered: outer hairs with 3–6 branches median, hairs situated before the inner hairs; both pairs simple, inner hairs rarely 2-branched; postclypeal hairs situated between the median hairs, thin, short, with 4 branches. Antenna nearly half as long as the head, nearly straight, with weakly developed spines and a hair tuft with 3–6 branches in the middle which are half as long as the antenna.

Comb on 8th segment with 18–29 (average 24) scales in 2–3 irregular rows, of markedly varying form: most scales near the dorsal side are shorter, without a main spine, and bear 2–3 longer spines and some shorter spines at the sides; the scales near the ventral side have a distinct main spine and smaller spines at the base. Siphon straight, tapering from the second third, index 2.5–3 (average 2.6). Pecten occupying basal third of siphon, with 15–24 (usually 20) closely spaced denticles and several rudimentary denticles at the base. Hair tuft situated in middle of siphon slightly basal to it, with 3–8 branches which are secondarily feathered.

264 Saddle extending to middle of sides of last segment; lateral hair simple, as long as the saddle; outer caudal hairs simple, long, inner hairs with 5–9 branches, half as long. Fin with 15–18 tufts on the common base and 1–3 shorter tufts before the base. The structure of the tufts is very characteristic: the branching begins far from the base and the long basal, single part of the tuft is 1.5–2 times as long as the lateral process of the common base. Gills as long as the saddle or shorter, leaf-shaped, the lower pair shorter than the upper.

Distribution. The species occurs in Europe from southern Scandinavia and Karelia, where it is distributed to 65°N (Lobkova, 1946) to Hungary, steppes of the Ukraine and the Northern Caucasus. It occurs in Kazakhstan, Siberia, Transbaikalia (Ulan-Ude) and Mongolia (Ulan-Bator). The boundaries of its distribution, especially in Asia, need more exact determination.

Biology. The larvae occur in open or partly shaded water bodies in spring, mainly in lowlands, on the edge of forests or in thinned parts, their bottom covered with fallen leaves, often near isolated trees. They are found in slightly saline water together with larvae of A. detritus, A. cataphylla and A. punctor. This is a widely distributed but not a mass species in the forest and forest-steppe. One generation per year. The mosquitoes appear in spring with the earliest species of Aedes. Flight ends in midsummer.

30. Aedes (Ochlerotatus) detritus Haliday, 1833
(salinus Ficalbi, 1896)

The species differs distinctly from the other species of the communis group, except A. simanini, in the coloration of the abdomen (Figure 171).

Proboscis and palps with brown scales with more or less numerous light scales. Mesonotum with yellowish brown and white scales. Integument of thorax brown. Pleurae of thorax with broad, white scales. Postcoxal spot absent, hypostigmal spot present. Femora variegated anteriorly; tibiae and tarsi with dark scales and with more or less numerous light scales. Wings with broad, dark and light scales. Abdomen dorsally with indistinct light transverse stripes at the base of the segments. Posterior part of tergites with brown and yellowish white scales, dark scales predominating on the anterior segments and light scales on the posterior segments.

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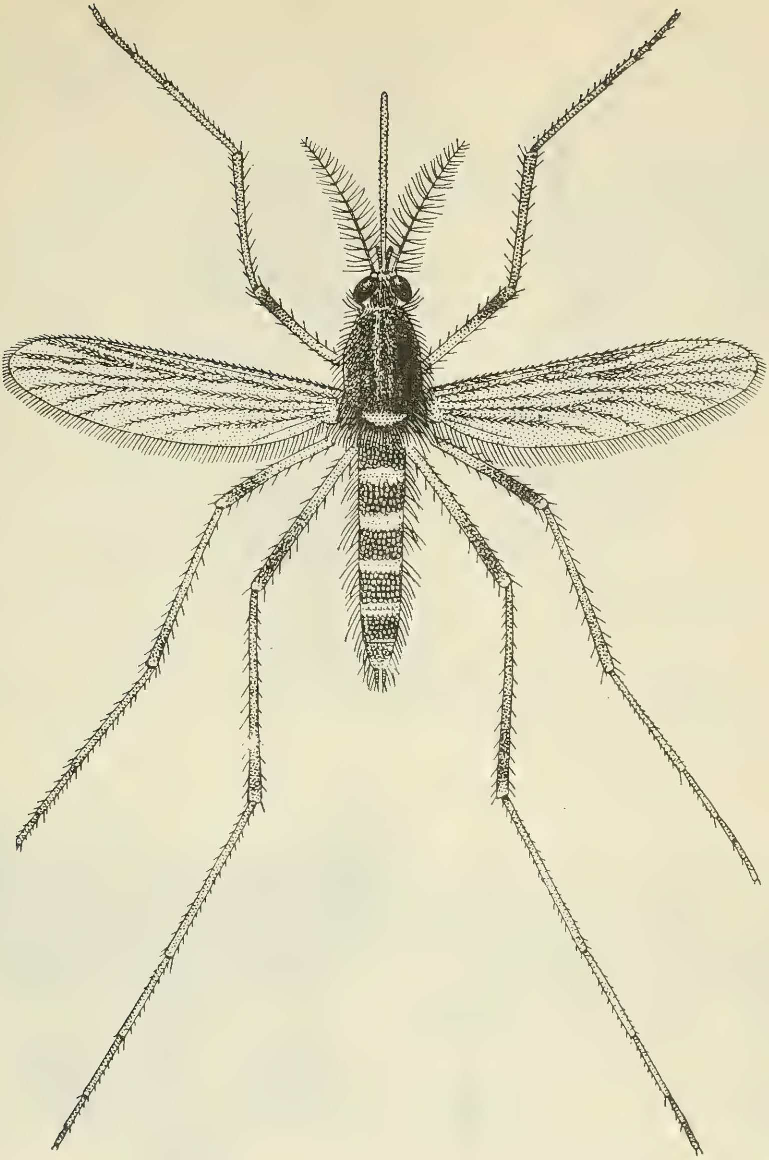

FIGURE 171. Aedes detritus Hal.

Hypopygium (Figure 172): hairs of coxite thick, long; ends of hairs of left and right coxite slightly overlapping. Basal lobe with one spine (strong seta) and shorter setae. Stem of claspette short, curved, wing with a manubrium; a plate-shaped widening present in the middle and apical part of the wing. Phallosome short, ovoid, without a constriction.

Fourth-stage larva (Figures 173 and 174) medium-sized, yellowish to brown; frontal hairs: outer hairs with 7–12 branches, median hairs with 1–3 branches (usually simple), situated before the inner hairs with 2–3

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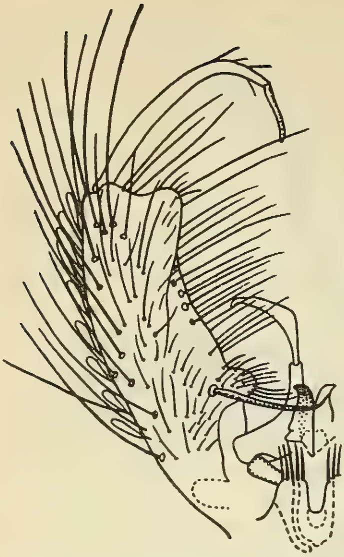

FIGURE 172. Hypopygium of Aedes detritus Hal.

branches; postclypeal hairs with 2–3 branches, thin, short. Antenna about 0.6 of the length of the head, thin, slightly curved, with sparse spines, hair tuft situated in the middle, with 5–8 (average 6) branches, half as long as the antenna.

265 Comb with a varying number of scales, 25–60 or more, scales without a main spine, short, tapering from the base, with a row of spines at the margin, the apical spines longer. Siphon short, index 2.2–2.5, slightly tapering from the middle. Pecten with 18–27 denticles, occupying half of the siphon, denticles regularly spaced, only the distal denticle sometimes more widely separated. Hair tuft situated in the middle or nearer to the base, with 6–10 (usually 8) branches. Stigmal plate differing in some characters of the structure of the "stirrup": it is not situated as usual in the middle of the plate between the spiracles, but displaced toward the posterior valves; the posterior arc is therefore absent and the posterior process has a very jagged posterior margin and thin, small branches; shoulders and processes of spiracles absent; anterior arc of "stirrup" strongly developed, strongly projecting into the space between the spiracles.

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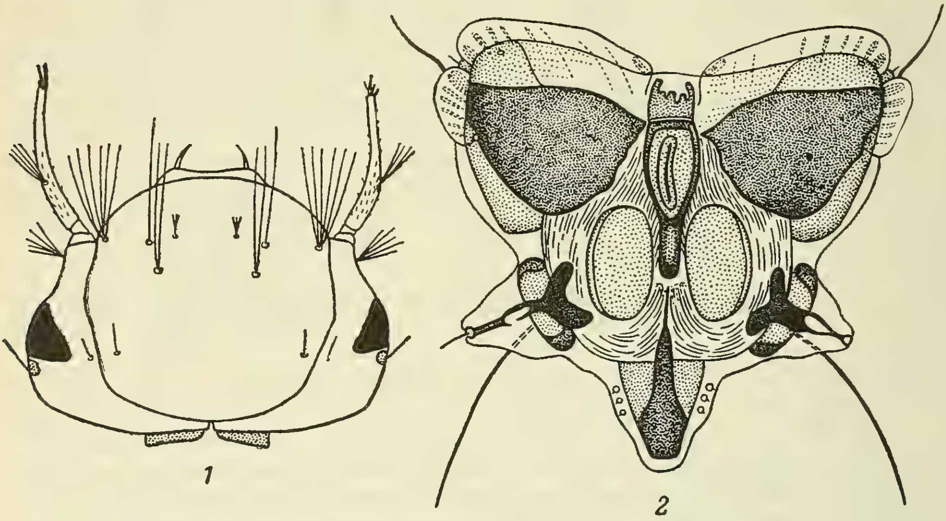

FIGURE 173. Aedes detritus Hal. Fourth-stage larva: 1 – head, dorsal; 2 – stigmal plate.

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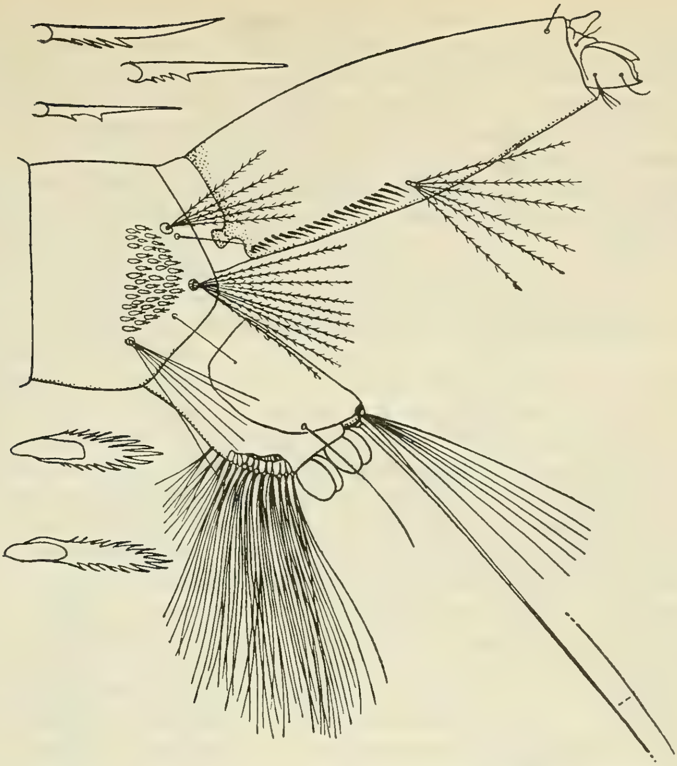

FIGURE 174. Aedes detritus Hal. Fourth-stage larva. Posterior end, lateral (after Marshall).

Saddle of last segment extending to middle of sides, lateral hair simple, as long as the saddle; outer caudal hairs long, longer than the siphon, inner hairs forming a fan with 8–11 branches. Fin with 16–18 tufts on the common base and 2–3 shorter tufts before the base. Gills very short, spherical.

Distribution. Western and Eastern Europe; to England and southern Scandinavia in the north; North Africa, Southwest Asia. USSR: Middle Asia and Kazakhstan. There are also records from the Leningrad region, Ukraine, Lower Volga area and West Siberia. Some of these records may be incorrect. It has also been recorded from Kashgar (Sinkiang) and from northwest Mongolia (Natvig, 1948).

Biology. The larvae occur in small, temporary, stagnant water bodies and pools in spring, mainly with markedly saline, rarely with fresh, water. In the south the water is predominantly saline, with 0.83–5.2% salts; often in marshes on the seashore. In Tadzhikistan and Kirghizia they are found in the mountains at 1,500–2,000 m above sea level and in water bodies formed by snowmelt. They occur sometimes together with A. caspius caspius, C. longiareolata and other species. In temperate latitudes there are
267 two or more generations per year after the summer rains; in southern latitudes there is one generation per year, possibly due to the early drying of the water bodies. An early spring species which hibernates in the egg

stage. The females attack man, sometimes in large numbers. The species is characteristic for areas near the sea and continental regions with abundant saline water bodies. In the USSR it is numerous in deserts and steppes in Turkmenia, Tadzhikistan and Uzbekistan. In a large part of its distribution (which has not been satisfactorily determined) it is considered as a relatively rare species.

A. detritus is probably an intermediate host of the filaria Dipetalonema evansi, which causes a serious disease of camels (Orekhov, 1952).

31. Aedes (Ochlerotatus) simanini Gutsevich, 1966

Closely related to A. detritus but differing in its darker color, the presence of a postcoxal spot of scales and the structure of the hypopygium.

Proboscis and palps with dark and light scales, light scales usually more numerous. Thoracic integument blackish brown. Mesonotum with yellowish bronze and whitish scales, the latter predominating laterally and before and on the scutellum. Pleurae of thorax with white scales except in the upper half of the proepimera, which is covered with straight, relatively broad, grayish scales. Postcoxal membrane densely covered with scales. 268 Hypostigmal spot continuing posteriorly in a stripe. Legs: fore and midfemora and tibiae variegated anteriorly; tarsi without light rings but with numerous white scales on all segments, white scales sometimes predominating; articulations of tarsi dark. Wings variegated, with large, brown and white scales on all veins. Abdominal tergites with blackish brown scales, and with broad, white, transverse stripes at the base of the segments. A few white scales on the dark part which covers most of the tergites; the light scales sometimes form an indistinct stripe also at the posterior margin of some segments.

Hypopygium (Figure 175): coxite with moderately long hairs, ends of hairs of left and right coxite not overlapping. Basal lobe of coxite with one large seta and smaller setae and hairs. Apical lobe present. Stem of claspette straight, wing with a plate-shaped widening, present only for a short distance near the base. Phallosome elongate-oval, with a slight constriction.

Fourth-stage larva medium-sized, yellowish brown, with darker head and lighter siphon (after A. M. Dubitskii).

Head nearly 1.5 times wider than long. Frontal hairs: outer hairs with 5 (3–8) branches, median and inner hairs simple (in 60% of specimens) or 2-branched (40%), all hairs with indistinct secondary feathering. Postclypeal hairs situated between median frontal hairs, with 2, rarely 3–4, short, thin branches. Sutural and transsutural hairs longer than the postclypeal hairs, with 1 or 2 branches. Antennae short, about 0.4 times as long as the head, with sparse spines; hair tuft situated in the middle slightly basal to it, with 4–5 (3–6) branches, not reaching the end of the antenna.

Median hairs of prothorax with slight secondary feathering: anterior and median hairs simple or 2-branched, posterior hair with 2–3 longer branches extending to posterior margin of eyes.

Comb usually with 22 (16–36) scales in 2, rarely 3, rows, forming a spot projecting posteriorly, half-moon shaped. Scales with a distinct main spine and a few spines at the sides of the base. Base of dorsal and ventral scales in the spot distinctly broader than the others. Hairs behind comb: dorsal hair with 5 (4–7), median hairs with 7 (6–9), ventral hair with 5 (4–8) secondarily feathered branches; intermediate hair smooth and simple. Darker, sclerotized plates of irregular form around the base of the dorsal and median hairs. Siphon (index about 3.4) slightly tapering apically. Pecten usually with 13 (12–17) equally spaced denticles and 2–4 smaller denticles at the base, occupying about $^1/_5$, at most $^1/_4$, of the basal part of the siphon. Denticles moderately long, with wider base and usually with one larger and 2–3 smaller accessory denticles at the base. Hair tuft with 5 (4–7) secondarily feathered branches, slightly longer than the width of the siphon at its position, situated in basal part of siphon but distinctly before the distal denticle of the pecten.

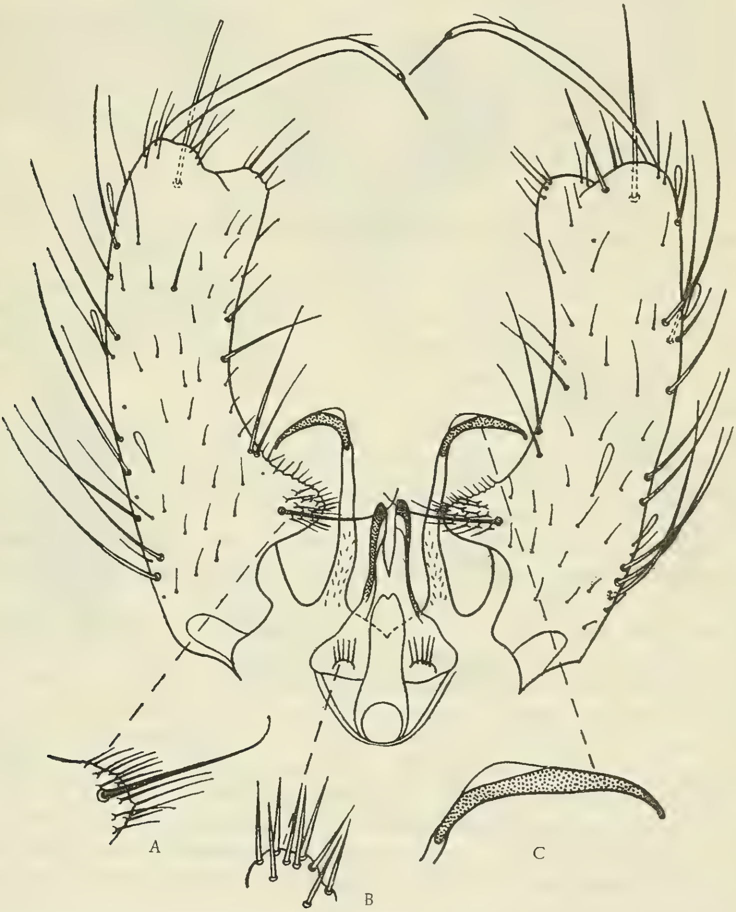

FIGURE 175. Hypopygium of Aedes simanini Guts:

A – basal lobe of coxite; B – lobe of tergite 9; C – wing of claspette. High magnification.

Last segment 1.5 times longer than wide. Saddle extending to middle of sides of segment, beyond it only in its anterior half. Lateral hair simple, rarely 2-branched, at most half as long as the saddle. Caudal hairs: outer hairs simple, usually as long as the siphon, inner hairs half as long, with 5 (4–8) branches. Fin with 17 (14–18) tufts on the common base and one, rarely 2, shorter tufts before the base. Gills short, leaf-shaped, at most $^1/_4$ as long as the saddle.

Biology. The larvae occur in temporary shallow water bodies, strongly polluted by organic matter, with a varying degree of mineralization, open and shaded, in the tugai zone and near inhabited areas. The larvae are very adaptable ecologically. They tolerate temperatures to -5, -7° for 3–4 days. Development continues at temperatures of 4–5°. An early spring species with one generation per year. The larvae are found at the end of March and the adults in early April. Flight and attacks at the end of April.

269 The species was described (Gutsevich, 1966) from material collected by P. I. Simanin in Kokand (Uzbekistan) in March–April 1929. It was also found in Kazakhstan. Iliisk village, Alma-Ata Region, vicinity of Alma-Ata, 1,800 m above sea level. It probably also occurs in Middle Asia but has not been distinguished from A. detritus.

32. Aedes (Ochlerotatus) kasachstanicus Gutsevich, 1962

The species is characterized by the white tarsi and upright scales on the hind tibiae. It cannot be placed in any of the groups of Palaearctic Ochlerotatus (Gutsevich, 1962). A. kasachstanicus differs from the other species of Ochlerotatus in its shorter proboscis, which is about as long as the fore femora.

270 Palps and proboscis of female with dark and light scales, the latter predominating in the middle of the proboscis. Palps of male with light rings. Mesonotum with dark chestnut scales and some whitish scales which form an indistinct border anteriorly at the sides of the mesonotum and also cover the scutellum and the area before the scutellum. Pleurae of thorax with broad white scales. Postcoxal spot of scales present, hypostigmal spot absent.

Femora and tibiae with light and dark scales anteriorly. On the hind tibiae, in addition to contiguous scales, are also upright, mainly dark scales; the upright scales on the tibiae are larger in the males. Tarsi light, dark only at apex of segments. Wings with relatively broad, white scales; white scales present on all veins, but brown scales predominate. On the abdomen, light scales predominate dorsally, dark scales are present mainly in the middle of the tergites. Cerci distinctly projecting.

Characters like the broad scales on the pleurae of the thorax and the upright scales on the hind tibiae stress the resemblance of A. kasachstanicus to species of the subgenus Mucidus, which occurs in the Ethiopian, Oriental and Australian regions.

Hypopygium (Figure 176): coxite with a basal and an apical lobe, apical lobe moderately large, basal lobe large, projecting, densely covered with long, seta-like hairs in several rows. Distinct spines or large setae absent on the basal lobe. Claspettes: stem straight, wing with a small, plate-shaped widening and with a hook-shaped denticle near the base.

(269)

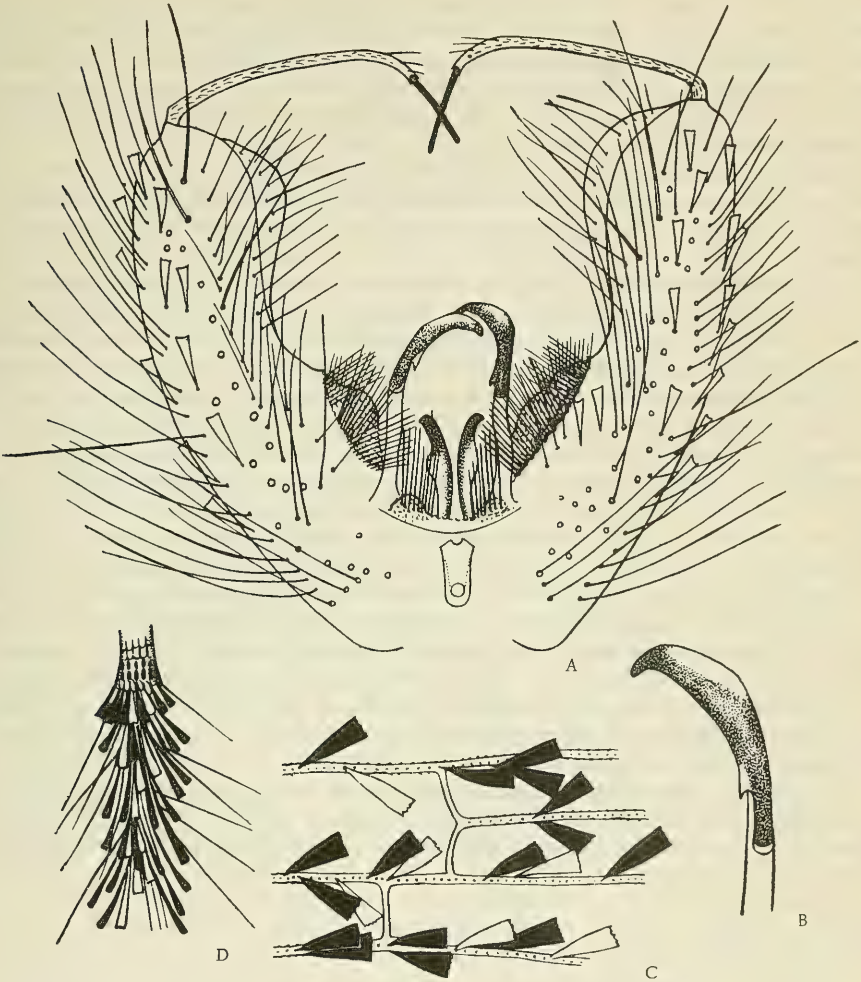

FIGURE 176. Aedes kasachstanicus Guts:

A – hypopygium; B – wing of claspette; C – area of cross veins of wing; D – part of hind tibia.

Distribution. Many localities along the Ili River (Alma-Ata Region, Kazakhstan).

Biology. Forests and shrub thickets in floodplains. It appears in May and attacks in large numbers in June. Flight ending in August. Apparently only one generation per year. Active bloodsuckers.

Fourth-stage larva medium-sized, dark brown with dark siphon and lighter head (after A. M. Dubitskii).

Head 1.4 times wider than long. Frontal hairs: outer hairs usually with 8 (6–11) branches, median hairs with 3 (2–4), inner hairs with 5 (4–7) branches with sparse secondary feathering hairs, postclypeal hairs situated between the median frontal hairs, with 3 (2–7) very short branches. Sutural hairs with 2 (1–3), transsutural hairs with 3 (2–4) thin branches. Antennae short, about half as long as the head, covered with sparse, small spines and with a tuft with 7–8 (6–11) branches situated in the middle of the antenna, slightly nearer to the base.

Inner median hairs of prothorax relatively short: anterior and median hairs with 1–2 branches, posterior hairs with 2–3, rarely with 4, longer, sparsely secondarily feathered branches, not reaching to posterior margin of eyes.

Comb usually with 31 (27–34) scales in 2–3 rows, forming a posteriorly projecting, half-moon-shaped spot. Scales with a distinct main spine and a row of thinner and shorter spines at the sides of the base. Hairs behind brush: dorsal hair with 4 (3–6), median hair with 6 (5–10), ventral hair with 5 (4–7) branches with distinct secondary feathering; intermediate hair smooth and simple. Siphon long, cylindrical in the basal third and tapering apically, index 3.9–4.0. Pecten usually with 20 (16–21) equally spaced denticles and with 2–6 small denticles at the base. Pecten occupying basal third of siphon. Each denticle with 2–4 accessory denticles at the slightly widened base. Hair tuft usually with 4 (3–5) secondarily feathered branches, slightly longer than the width of the siphon at its position, situated distal to the end of the pecten at a distance of the length of one denticle.

Saddle of last segment twice as long as wide, extending beyond middle of sides of segment. Lateral hair simple, slightly shorter than the saddle. Caudal hairs: outer hairs simple, slightly longer than siphon, inner hairs half as long, with 9 (8–10) branches. Fin with 16 (12–18) tufts on the common base and with 2–3 shorter tufts before the base. Gills short, about one-third as long as saddle, ovoid or leaf-shaped.

Biology. Breeding places are only water bodies formed by flooding of the rivers in spring or thawing snow, mainly in the tugai* zone with abundant fallen leaves and slightly saline water. A late spring species; one generation per year.

(270a)

SUPPLEMENT

While the manuscript was in press, new data on mosquitoes of the USSR have been obtained: two new species, Aedes (Ochl.) montchadskyi Dub., 1968 and Aedes (Ochl.) stramineus Dub., 1970, have been described. Two species new for the fauna of the USSR have been found. They are Aedes (Ochl.) fitchii Felt and Young and A. (Ochl.) rempeli Vocker. The authors are especially grateful to A. M. Dubitskii (Alma-Ata) and P. E. Polyakova (Novosibirsk) for providing material of larvae and adults of these species and data on their biology.

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* [Formation with forest shrubs and meadows in river valleys (Middle Asia).]

Aedes (Ochlerotatus) montchadskyi Dubitzky, 1968

Female. Proboscis and palps with dark and light scales; apex of proboscis dark. Scales of mesonotum mainly golden yellow; whitish scales at the margins of the mesonotum and also forming 2 small spots in its middle. Pleurae of thorax with white scales that extend to the anterior corner of the sternopleura and to the lower margin of the mesepimera. Hypostigmal spot present, postcoxal spot absent. Femora and tibiae mainly with dark and light scales anteriorly. Tarsi without light rings; anterior surface of first 2 or 3 segments of tarsi with dark scales, posterior surface with light scales; lateral surface of tarsi with light scales, mainly in basal part of segments, forming indistinct light rings; terminal segments of tarsi dark. Wings with dark scales, with numerous light scales on the costa and r_1. Abdomen dark dorsally and with light stripes at the base of the tergites, which are wider laterally and occupy about $^1/_4$ of the length of the tergite; light scales on the dark background absent.

Male. Coloration as in the female but the light abdominal stripes are wider, occupying about $^1/_3$ of the length of the tergite. Hypopygium: coxite with moderately long hairs; basal lobe large, with a curved spine, a row of setae and several rows of hairs; apical lobe moderately large. Stem of claspette slightly curved, wing narrow, with a small, plate-shaped widening. Processes of tergite 9 with 5–8 setae.

Fourth-stage larva grayish brown, with distinct secondary feathering on the hairs of the body.

Head slightly wider than long. Frontal hairs: outer hairs with 8–10 branches, median hairs with 2–3, inner hairs with 3–4 branches; inner hairs longer than the median hairs. Postclypeal hairs short, with 2–3 branches. Sutural hairs simple, transsutural hairs shorter, with 2 branches. Antennae at most half as long as the head, with sparse spines; hair tuft short, with 6–8 branches, situated in the middle, slightly nearer to the apex.

Median hairs of prothorax: anterior hairs thinner and shorter, extending to middle of compound eyes, posterior hairs thick, distinctly longer; both pairs 3-branched from the base; intermediate hairs simple, as long as the anterior hairs; all with sparse secondary feathering.

Comb usually with 27 (22–23) scales in 2–3 rows, forming a half-moon-shaped spot which is convex posteriorly; scales of varying size and form, the shorter scales with a row of spines at the distal end, the longer scales with a main spine and sparse, shorter spines at the sides of the base. Hairs behind the comb strongly developed: dorsal hair with 4–7 branches, median hair with 5–7, ventral hair with 3 branches; intermediate hairs smooth and simple.

Siphon tapering toward the apex, index 3.3–3.5. Hair tuft situated in the middle, slightly nearer to the base, with 5–8 branches, 1.5–2 times longer than the width of the siphon at its position. Pecten with 10–20 thin, contiguous denticles with 2–5 accessory denticles at the base, the distal denticle not reaching to the hair tuft.

Saddle distinctly longer than wide, nearly extending to ventral margin of segment. Lateral hair characteristic, with 3 (rarely 2 or 4) secondarily feathered branches, distinctly longer than the saddle. Outer caudal hairs simple, 1.5 times as long as the siphon, inner hairs with 8–10 secondarily feathered branches, more than half as long as the outer hairs. Fin with 17–18 tufts on the common base and one shorter tuft before the base. Gills small, oval, $^1/_4 - ^1/_6$ as long as the saddle.

Distribution and biology. Southeast Kazakhstan. Floodplains of the upper and middle reaches of the Ili River. In small temporary ponds in spring, in tugai thickets or near them, in water with a varying degree of mineralization. A late spring species, one generation per year.

Note on systematics. It belongs to the communis group; the arrangement of the light scales on the tarsi resembles that in species of the cantans group. The variegated coloration of the femora and tibiae and the white scales on the wing place this species near A. leucomelas, but it differs from it in the coloration of the thorax and structure of the hypopygium.

270 b

Aedes (Ochlerotatus) stramineus Dubitzky, 1970

Female. Proboscis mainly with white scales, apex dark. Palps with dark and light scales. Mesonotum without a stripe, with yellowish scales which are darker at the margin, lighter in the posterior third. Pleurae of thorax with white scales to the anterior corner of the sternopleura and to the lower margin of the mesepimera. Hypostigmal and postcoxal spots of scales present. Femora and tibiae with dark and light scales anteriorly, tarsi with indistinct light rings at the apex of one segment and base of the next segment. Wings mainly with light scales and more or less numerous dark scales on the costa and other veins. Wing membrane yellowish. Abdomen with uniformly yellowish white scales dorsally.

Male. Coloration as in the female. Hypopygium: coxite with short hairs and a few, thick, long hairs at the apex; basal lobe of coxite convex, with two spines in the distal part, a larger, hook-shaped spine in the apical half, and a smaller, straight spine; the lobe also bears a row of setae which are nearly as thick as the spines and several rows of hairs; apical lobe weakly developed, indistinct. Stem of claspette straight, short; wing of claspette as long as the stem, moderately sclerotized, slightly wider in the distal half. Processes of tergite 9 with 6–8 short setae. Phallosome broad, with a slight constriction.

Fourth-stage larva medium-sized (to 1 cm), muddy brown to dark brown, with dark head and lighter siphon.

Head slightly wider than long. A dark spot in the middle of the frontoclypeus which is distinct against the lighter lateral sclerites. If the pigmentation of the frontoclypens is less strong, it is wider anteriorly, then becomes narrower and widens again, attaining its greatest width between the inner frontal hairs; it then narrows again and becomes wider at the median frontal hairs. The pigmentation increases with age and its outline becomes less distinct because of the general darkening of the head capsule. Frontal hairs: outer hairs with 9–11 secondarily feathered branches, median hairs simple, inner hairs with 5, rarely with 3–6 branches. Postclypeal hairs situated between the median frontal hairs, short, with 3–4 branches. Sutural hairs short, simple, transsutural hairs much longer, with 2 branches. Antenna $^2/_3$ as long as the head, with small spines; hair tuft situated in the middle, with 5–8 branches.

Inner median hairs on prothorax: anterior hairs shorter, reaching to posterior margin of eyes, with 3–4 branches, posterior hairs slightly longer, with 3–6 branches; both pairs branched from the base; intermediate hairs simple, as long as the posterior hairs. None of the hairs feathered.

Comb of 8th segment usually with 30 (24–36) scales which form a triangular spot. Scales of varying size and form, shorter and wider with a row of spines at the distal end to narrower and longer, pointed but without a distinct main spine, with a row of spines which become shorter toward the base at the lateral margin. Hairs behind the comb: dorsal hair with 7–9, median hair with 9–10, ventral hair with 6–7 secondarily feathered branches; intermediate hair smooth and simple.

Siphon tapering from the middle, index 3.1–3.3. Hair tuft with 7–9 secondarily feathered branches, at most 1.5 times longer than the width of the siphon at its position, situated beyond the middle, slightly distal to it. Pecten with 29–33 regularly spaced denticles, occupying the basal half of the siphon, not reaching to the tuft for the length of one denticle; denticles thin, long, with a row of weak denticles at the base.

Saddle nearly twice as long as wide, reaching to the middle of the sides of the segment. Lateral hair simple, thin, slightly more than half as long
270c as the saddle. Caudal hairs: outer hairs simple, nearly 1.5 times as long as the siphon, inner hairs with 12–14 branches, a third as long as the outer hairs. Fin with 14–16 tufts on the common base and 1–2 (rarely 3) shorter tufts before the base. Gills short, $^1/_5$– $^1/_6$ as long as the saddle, oval, the lower pair slightly shorter than the upper.

Distribution and biology. Described from Kazakhstan (Dubitskii, 1970). Mosquitoes which probably belong to this species occur in many parts of Middle Asia, in Kazakhstan and West Siberia. It develops in spring in large, open, saline temporary ponds together with A. detritus and A. montchadskyi. One generation per year.

Note on systematics. It is closely related to A. caspius from which it was not distinguished in the past.

Aedes (Ochlerotatus) fitchii Felt and Young, 1904

Large, dark mosquitoes.

Female. Proboscis dark, palps mainly with dark scales and with a few light scales. Mesonotum with yellowish bronze scales and with a longitudinal dark brown stripe and small, indistinct, whitish spots. Pleurae of thorax with white scales which extend to the anterior corner of the sternopleura and do not reach the lower margin of the mesepimera. Hypostigmal spot of scales absent, postcoxal spot present. Femora and tibiae variegated anteriorly. Tarsi with white rings at the base of the segments; last two segments of fore tarsi and one segment of the mid-tarsi dark; rings on median segments of hind tarsi about half as long as the segment. Wings mainly with dark scales and more or less numerous light scales. Abdomen with light stripes dorsally which are broad at the base of the tergites and narrow at the apex; light scales predominate on the posterior tergites.

Male. Coloration as in the female. Hypopygium: coxite with relatively short hairs; basal lobe large, rounded or blunt-conical, slightly asymmetrical; lobe with one spine and numerous thick, dense hairs; apical lobe strongly convex. Stem of claspette slightly S-shaped or nearly straight; wing of claspette shorter than stem, slightly sclerotized, narrow, with a small incision at the base. Processes of tergite 9 with 7–9 long setae. Phallosome cylindrical, elongate, with a deep incision at the apex.

Fourth-stage larva medium-sized. Head at least 1.5 times wider than long. Frontal hairs secondarily feathered, inner hairs with 3–4, rarely 2, branches, median hairs situated before the inner hairs, with 2–3 shorter branches, outer hairs forming a tuft with many branches. Postclypeal hairs situated between the median frontal hairs, short, with 3–4 branches. Sutural and transsutural hairs simple. Antennae about half as long as the head, with spines, hair tuft situated near the middle, but not reaching the end of the antenna.

Median hairs of prothorax secondarily feathered, inner hairs simple or with 2–3 branches, median hairs long and simple, outer hairs long, with 2 branches or simple.

Comb with 12–28 scales with a distinct main spine and a row of spines $^1/_4$ – $^1/_3$ as long as the main spine at the base. Hairs behind comb long, the median, the dorsal, and the ventral hair with 3–4 secondarily feathered branches, intermediate hair smooth and simple.

Siphon (index 4–5) tapering from near the base, cylindrical in the apical fourth. Pecten with 15–24 regularly spaced denticles, not quite reaching middle of siphon; denticles longer apically. Tuft with 3–6 branches with slight secondary feathering, situated near the middle, beyond the distal denticle of the pecten. Hairs on posterior valves well developed, curved.

Last segment long, saddle extending slightly beyond middle of sides. Lateral hair simple, smooth, as long as the saddle. Outer caudal hairs long, simple, inner hairs forming a fan with 6 branches. Fin with 1 or 2 tufts before the common base. Gills pointed, lanceolate, 1.5–2 times as long as the saddle.

Distribution and biology. It was found in the Magadan Region on the Anadyr' River and in the middle reaches of the Kolyma River at about 64°N (Polyakova, 1970). It appears in June, flies to the end of August and attacks people in large numbers. Widespread in the western hemisphere: Alaska, Canada, U.S.A.

Note on systematics. It belongs to the cantans group. The species cannot always be determined with certainty by the females because of the resemblance to other species of the group, mainly A. riparius.

270 d

Aedes (Ochlerotatus) rempeli Vockeroth, 1954

The description of the adults is taken from the literature (Vockeroth, 1954; Carpenter and La Casse, 1955) because we had no material. Only the larvae have been found in the Soviet Union to date.

Female. Proboscis dark, palps with dark scales and with a few light scales. Mesonotum with grayish yellow scales and with a dark brown longitudinal stripe. Pleurae of thorax with whitish scales which reach the lower margin of the mesepimera. Hypostigmal and postcoxal spots absent.

Abdomen dark dorsally, with light stripes at the base of the tergites. Femora and tibiae dark anteriorly with a small admixture of light scales. Tarsi dark. Wings with dark scales, only a few light scales at the base of the costa.

Male. Coloration as in the female. Hypopygium: coxite with long hairs, basal lobe large, conical, without a spine, with a few setae in a row in which they gradually become shorter; apical lobe small, with only a few short hairs. Stem of claspette curved, wing slightly shorter than the stem, with a widening in the basal third, curved and tapering at the apex. Phallosome about as wide as long.

Fourth-stage larva dark brown to black, medium-sized, with dark head and siphon.

Head slightly wider than long. Frontal hairs with sparse secondary feathering: median hairs situated before the inner hairs, both pairs simple; outer hairs with 4–6 thinner branches with weak secondary feathering. Postclypeal hairs situated between the median frontal hairs, short, with 4–5 branches. Sutural hairs thin, simple, transsutural hairs shorter, with 2 branches. Antennae short, 0.5–0.6 times as long as the head, covered with spines; hair tuft with 5–7 thin branches, not reaching the end of the antenna, situated in the middle, slightly nearer to the base. Inner median hairs of prothorax smooth, the 2 anterior hairs simple and thinner, posterior hairs 2-branched from the base.

Comb with 32–46 (average 38) scales forming a spot which is slightly curved posteriorly. Scales of varying size and form, long and narrow to broad and short, mainly at the ventral margin. Scales without main spine or rarely with a weak spine, their apical margin with a row of spines. Hairs behind the comb; dorsal hair with 2–4, ventral hair with 2–6, median hair with 4–7 secondarily feathered branches, intermediate hairs smooth and simple.

Siphon tapering in the terminal third; index 3.5–4. Hair tuft with 8–12 secondarily feathered branches, situated near the middle of the siphon, distinctly nearer to the base. Pecten with 20–23 adjacent denticles, occupying only slightly more than the basal fourth of the siphon. Subapical spines well developed. Hairs on posterior valves of stigmal plate hook-shaped.

Last segment short, slightly longer than high. Saddle surrounding the segment like a ring, saddle much longer dorsally than ventrally. Lateral hair simple, distinctly longer than the saddle. Outer caudal hairs simple, smooth, 1.5 times as long as the siphon, inner hairs with 4–5 shorter branches. Fin with 14–16 tufts on the common base and 1–2 shorter tufts before the base; the unbranched base of each tuft is about 2–3 times longer than the process of the base, the length of the unbranched base increases from the anterior to the posterior tufts. Gills narrow-lanceolate, 1.7–2 times as long as the saddle, weakly pigmented.

Distribution and biology. The adults were described from Canada (Vockeroth, 1954). In the USSR, it occurs in Yakutia (Aksenova and Anufrieva, 1969), in parts of Siberia (Baraba Steppe, Kolyma basin (material of P. E. Polyakova and L. P. Kukharchuk), and also in the Altai in East Kazakhstan (Dubitskii and Tupitsin, 1970). The record of A. (O.) nigripes from Saratov probably refers to A. (O.) rempeli.

Bibliography to the supplement

Aksenova, A.S. and V.N. Anufrieva. Fauna i nekotorye voprosy biologii gnusa v raione almaznykh razrabotok v Yakutskoi ASSR (Fauna and Some Aspects of the Biology of Bloodsucking Flies in Diamond Mining in Yakutia). – Meditsinskaya parazitologiya i parazitarnye bolezni, 47, 1:8–16. 1969.

Dubitskii, A.M. Novyi vid komara Aedes montchadskyi sp. n. iz basseina Ili (A New Species of Mosquito, Aedes montchadskyi sp. n., in the Basin of the Ili River). – Parazitologiya, 2, 3:218–224. 1968.

Dubitskii, A.M. Novyi vid komara Aedes stramineus sp. n. (Diptera, Culicidae) (A New Species of Mosquito, Aedes stramineus sp. n. (Diptera, Culicidae)). – Ibid., 4, 5:408–413. 1970.

Dubitskii, A.M. and Yu.N. Tupitsin. Opisanie lichinok novogo dlya fauny SSSR komara Aedes (O.) rempeli Vockeroth (Description of the Larvae of Aedes (O.) rempeli Vockeroth, a New Species of Mosquito for the Fauna of the USSR). – Ibid., 4, 2:171–174. 1970.

Polyakova, P.E. Novyi dlya fauny SSSR vid komara (Diptera, Culicidae) Aedes fitchii Felt and Young (Aedes fitchii Felt and Young, a New Species of Mosquito for the Fauna of the USSR (Diptera, Culicidae)). – Ibid., 4, 4:389–391. 1970.

270 2. Subgenus Aedimorphus Theobald, 1930
(Ecculex Felt)

Closely related to the subgenus Ochlerotatus, but differing in the structure of the hypopygium; claspettes absent, basal lobe of coxite usually strongly developed, sometimes flask-shaped; rod-shaped appendage (if present) situated before apex of style; aedeagus divided into two serrated plates. The larvae do not differ from larvae of Ochlerotatus.

The subgenus is distributed in the Ethiopian and Oriental regions and contains over 90 species. It is represented in the Palaearctic by two species, one widely distributed, the other, A. alboscutellatus Theob., occurring only in the south of Japan.

33. Aedes (Aedimorphus) vexans Meigen, 1830

The narrow, light rings at the base of the tarsal segments (Figure 97) are characteristic.

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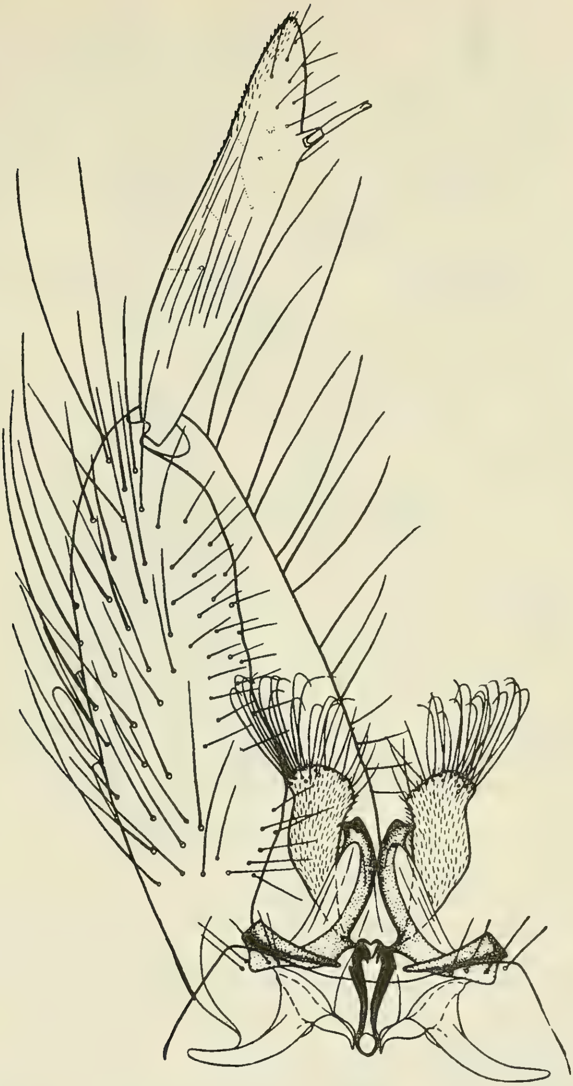

FIGURE 177. Hypopygium of Aedes vexans Mg. (after Carpenter and La Casse)

Proboscis and palps with brown scales with a few white scales. Mesonotum with reddish brown or bronze colored scales. A small area before the scutellum and the scutellum covered with golden scales. Femora and tibiae with dark scales anteriorly and with some scattered white scales. Tarsi dark, with white rings, which usually occupy not more than $^1/_5$–$^1/_4$ of the length of the segment. This distinguishes it from species of the cantans group in which the rings are wider. The width of the light rings varies markedly. Specimens with relatively wider rings resemble A. cantans, but this species differs in the coloration of the mesonotum and abdomen and the presence of white scales on various veins of the wing. The wings of A. vexans are covered with brown scales, isolated light scales are present only at the base of the wing. The coloration of the abdomen varies in the two subspecies.

Hypopygium very characteristic (Figure 177): basal lobe nearly divided from the coxite in the form of a flask-shaped process with wider end which is densely covered with hairs; style broad, plate-shaped, with a rod-shaped appendage, situated far from the apex of the style.

The larvae of A. vexans are very variable because of the distribution of the species and different conditions of development and habitats of the adults, especially in the habitat characters, so that there are apparently ecological and geographical intraspecific differences. However, a comparison of the descriptions of larvae from Europe, Asia, Africa and North America and examination of the material available in the USSR show that it is not possible to distinguish the larvae from different localities.

Fourth-stage larva (Figure 178) medium-sized (south) to large
272 (north), yellowish in the south to dark brown, nearly black in the north. Frontal hairs secondarily feathered, outer hairs with 6–12 (usually 7–9), median hairs situated before the inner hairs, slightly more widely separated, with 1–2 (rarely 3) branches, inner hairs with 2–5 (usually 3–4) branches. Postclypeal hairs with 2–5 short, thin branches, situated between the median hairs. Antenna about half as long as the head, with moderately distinct spines which are more distinct in the northern forms, hair tuft with 5–12 branches (half as long as the antenna), situated at $^1/_3$ of its length from the base.

Comb with 7–13 (usually 8–10) scales with a pointed main spine and a row of thin spines at the sides of the base. Siphon tapering from the second third, its length very variable: index 2.5–4.3 (average 3.0–3.5), less in southern forms. Pecten extending to middle of siphon or beyond it (in larger larvae), consisting of 12–25 (usually 18–20) denticles, 1–3 denticles at the base rudimentary and 1–3 distal denticles more widely separated and larger than the others. Hair tuft situated in the apical part, with 3–8 (usually 4–6) short branches.

Saddle on last segment extending to middle or lower margin of the sides; lateral hair simple, rarely with 2–3 branches; outer caudal hairs simple, longer than the siphon, inner hairs with 4–9 branches, half as long. Fin with 11–13 tufts on the common base and 3–4 shorter tufts before the base. Gills 1.5 times as long as the saddle or longer, lanceolate, not pigmented, both pairs of the same length or the lower pair slightly shorter.

Distribution. Europe, Asia, Africa, North America. It extends in Europe to about 60–62°N in river valleys and outside them. It is especially widely distributed in Asia: Middle Asia, Kazakhstan, Siberia, Far East, Japan, China, Indo-China, India, Iran, Asia Minor. It is distributed from the Mediterranean coast of Africa to South Africa. In America, from the south of Canada to the Gulf of Mexico.

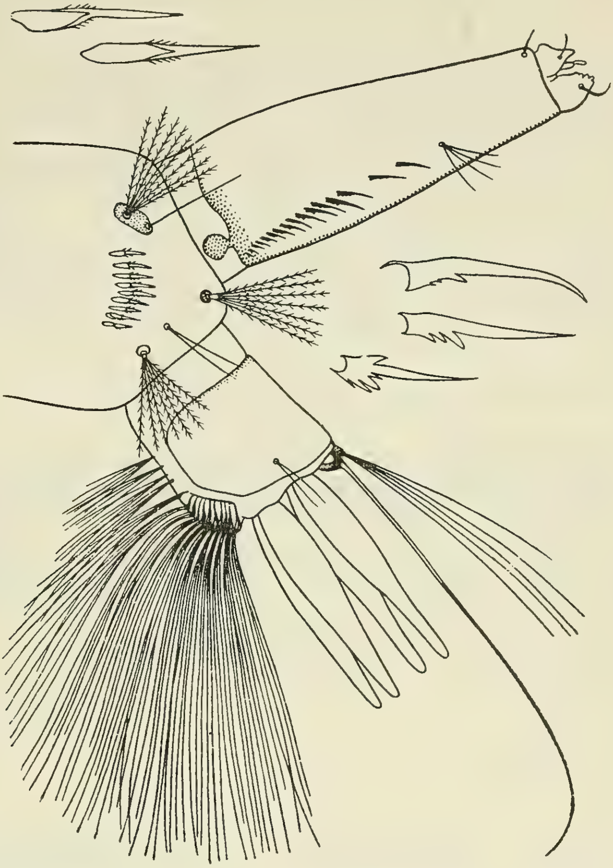

FIGURE 178. Aedes vexans Mg. Fourth-stage larva. Posterior end, lateral (after Marshall).

Biology. The larvae are restricted in the south to fresh or saline water bodies in floodplains, floodplains of deltas after the spring floods, with little vegetation. It occurs in the north in various water bodies in
273 spring (puddles, ditches, pools) in open water or at the edge, but in fresh water. Its numbers are especially large in floodplains and river deltas. Flight begins in spring, slightly later than in most other species of Aedes. The spring generation is usually small. After the summer rains or summer floods of rivers from the south there is a second generation and flight may continue to the autumn. The period of mass activity lasts 2–4 months.

The seasonal numerical curve often has 2 or several peaks and the maximum may occur in different months depending on the conditions in the rivers and the distribution of rainfall in summer.

Mass breeding of A. vexans has been observed in many parts of the distribution, including the Maritime and Khabarovsk territories, lower reaches of the Danube, Dnieper, Don, Volga and Terek, some parts of Transcaucasia, the Rhine valley and many parts of the U.S.A. The species often predominates among insects attacking people and animals. The mosquitoes may fly 10–20 km and further from their breeding places. They attack mainly in the open but also enter houses and cattle sheds in large numbers.

Epidemiological importance. In foci of tularemia A. vexans may play a part in spreading the disease. Natural infections have been found and it also transmits tularemia experimentally. A virus of the group of lymphocytic choriomeningitis was isolated in Transcarpathia from A. vexans, and Tahyňa virus in Slovakia. The species transmits eastern equine encephalitis in the U.S.A. The larvae of Dirofilaria immitis may develop in A. vexans to the infective stage.

Aedes vexans vexans Meigen

Abdomen with brown scales dorsally and white transverse stripes at the anterior margin of the tergites which are slightly narrower in the middle, the stripes resembling a horizontal letter B. Posterior margin of last tergites often with white scales. Specimens from Transcaucasia and Middle Asia usually differ in the light color of the scales and integument of the mesonotum.

Description of the larvae on p. 291.

Distribution. Europe, America, Africa, West Asia, Kazakhstan, Siberia.

Aedes vexans nipponii Theobald, 1907

The subspecies differs in its slightly larger size and the numerous light scales on abdomen, proboscis, palps, femora and base of the wings. In addition to the broad transverse stripes, light scales form spots on the abdomen in the form of a longitudinal stripe (usually on the anterior segments) or in the form of a triangle with the apex anteriorly, usually on the posterior segments. Light scales sometimes predominate on the posterior tergites. Light scales are present at the base of the wing but there are very few on other parts of the wing.

The larvae do not differ from those of the nominate subspecies.

Distribution. The subspecies is distributed mainly in the Far East:
274 Maritime and Khabarovsk territories, Transbaikalia, Mongolia, China, Japan, also in Siberia and Kazakhstan. The two subspecies are connected by transitions. There may be "typical forms" and transitional forms in the same locality.

3. Subgenus Finlaya Theobald

Differs from the other subgenera of Aedes mainly in the structure of the hypopygium. Claspettes present. Basal lobe of coxite absent or weakly developed, apical lobe absent. Appendage of style situated at the apex. Aedeagus simple, not divided. Palps of male usually slightly shorter than the proboscis.

The posterior segments of the abdomen of the female are of characteristic structure: 8th sternite broad, not retracted into the preceding segment; cerci short (in contrast to the two preceding subgenera). Proboscis distinctly longer than fore femora. Coloration: white spots at sides of abdomen. The light scales on the abdomen usually not white in species of Ochlerotatus. Proboscis and wings of Palaearctic species of Finlaya with dark scales.

The larvae of Finlaya show no differences from those of the other Palaearctic subgenera of Aedes. The antennae are usually without spines, they are rarely weakly developed; hair on the antenna simple or 2-branched. The hairs on the body are stellate or form strongly developed spines. Siphon short, with distinct auricles at the base. Denticles of pecten often forming a curved or slightly S-shaped row. Gills of different form; fin developed in inverse proportion to their size.

The larvae of most species occur in small water bodies (tree holes, leaf-axils, holes in bamboo stems, rock pools, etc.). The biotopes of the species are specific, so that the distribution of most species is sporadic and often narrow.

About 190 species of this subgenus are known, most of them from the Oriental region. Most of the species in the Palaearctic region are connected with the Oriental groups. Five species occur in the USSR, only one in Europe, the others only in the Far East.

The species of Finlaya are usually not mass bloodsuckers but some transmit Japanese encephalitis and filariasis and a few species apparently transmit yellow fever (Aedes leucocelaenus Dyar and Shannon in South America).

34. Aedes (Finlaya) geniculatus Olivier, 1791
(ornatus Meigen, 1818)

Large mosquitoes with a broad, dark longitudinal stripe on the mesonotum and white spots at the apex of the femora (Figure 179). Proboscis with dark scales, legs and abdomen with a violet tone.

Proboscis and palps with black scales. Mesonotum with a broad, sharply defined longitudinal stripe of blackish brown or chocolate brown scales, or with 2 approximate dark stripes; two other dark stripes at the sides of the posterior half of the mesonotum. Lateral parts of mesonotum with silvery gray or cream-colored scales. Scutellum with narrow, yellowish scales. Pleurae of thorax with spots of broad, white scales. Tibiae and 275 tarsi with black scales. At the apex of the femora is a small spot of white scales, distinct against the black tibiae and distal part of the femora. Claws of fore and mid-tarsi of females with one denticle, simple on the hind tarsi. Wings with brown scales. Abdomen with black scales dorsally and triangular, white spots at the sides of the segments.

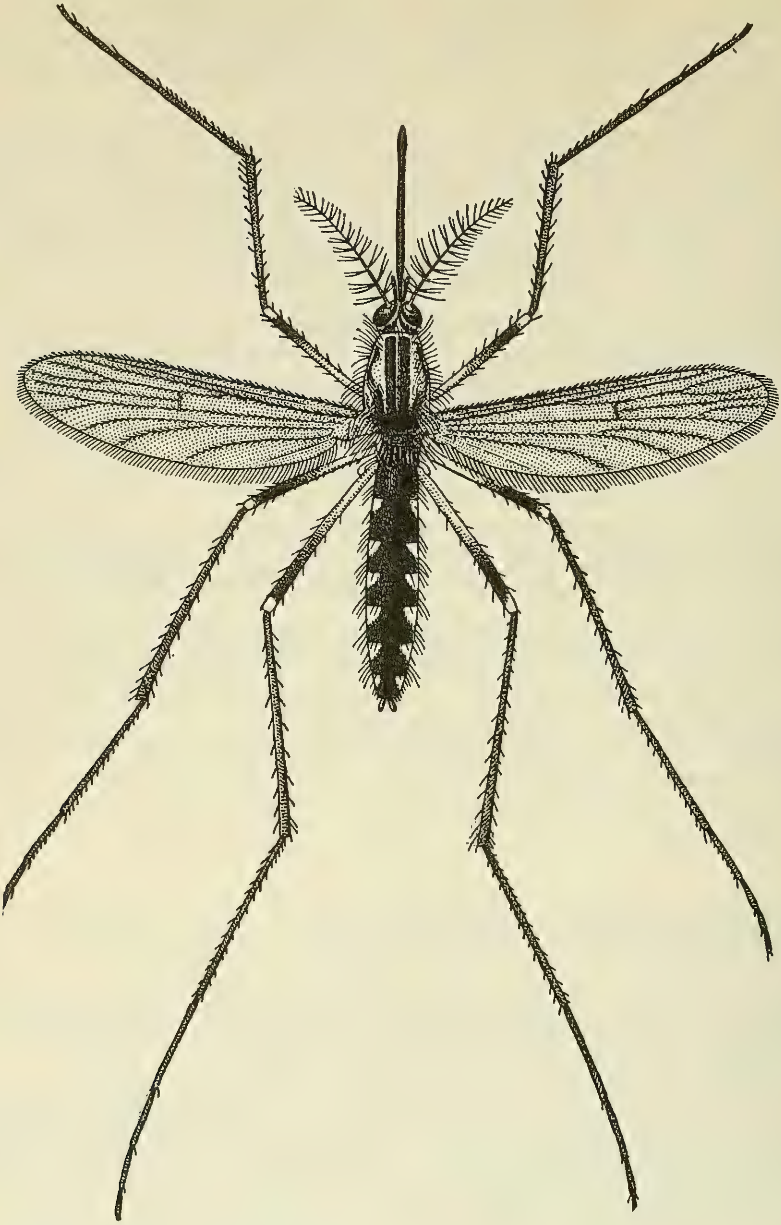

FIGURE 179. *Aedes geniculatus* Ol.

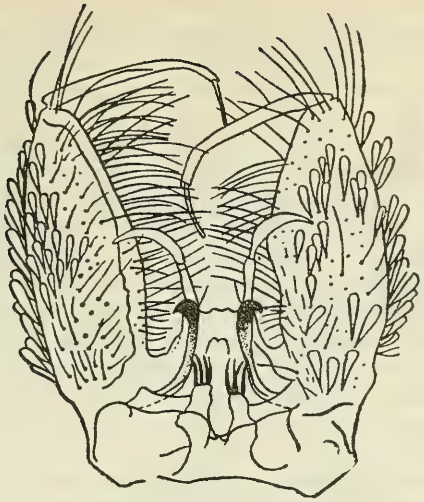

FIGURE 180. Hypopygium of *Aedes geniculatus* Ol. (after Natvig)

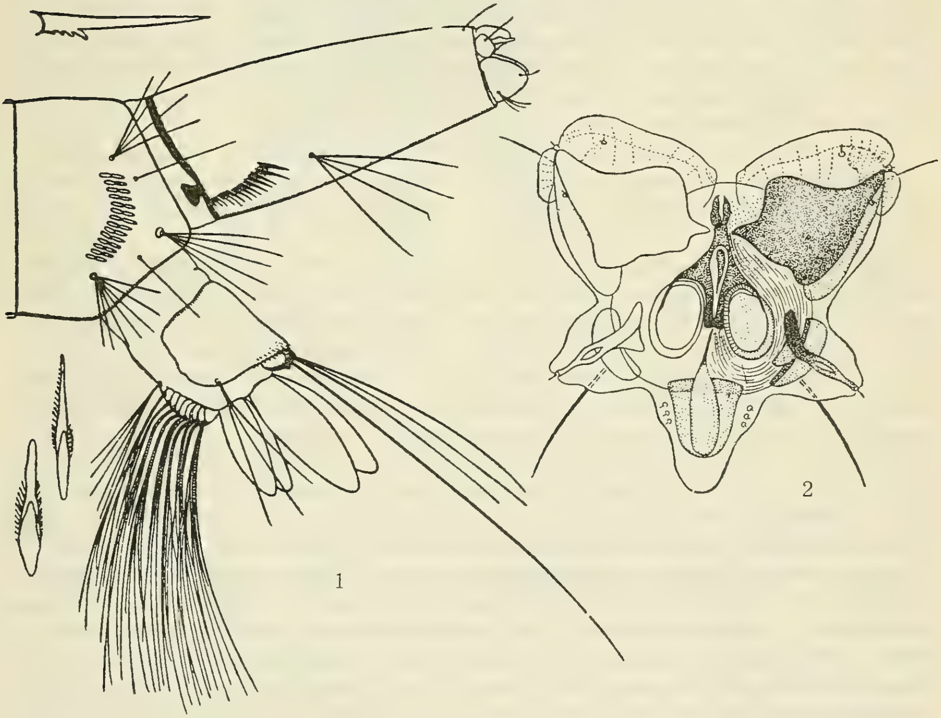

FIGURE 181. *Aedes geniculatus* Ol. Fourth-stage larva: 1 – posterior end, lateral (after Marshall); 2 – stigmal plate.

Hypopygium (Figure 180): coxite densely covered with scales on the outside and with hairs; basal lobe forming a small tubercle with hairs and without spines or setae. Stem of claspette straight, longer than wing; hair on stem situated nearer to the base; wing of claspette narrow, curved. Lobes of tergite 9 with 3–6 setae.

Fourth-stage larva (Figure 181) large, weakly pigmented, grayish or yellowish, with darker head and siphon; the marked stellate branching of the hairs gives the larvae a spinose appearance. Frontal hairs weakly developed: outer hairs short and thin, with 2–4 branches, median hairs displaced anteriorly, with 1–2 (usually) thicker branches, situated before the inner hairs, simple, but twice as long as the inner hairs; postclypeal hairs situated between the median hairs, with 7–8 short, thin branches forming a fan. Antenna thin, about half as long as the head, without spines, with a simple, rarely 2-branched, short hair.

277 Comb on 8th segment with 11–15 scales in a posteriorly curved row, scales with a long main spine and with short, thin setae at the margin near the base. Siphon straight, short, index about 3.0. Pecten with 14–20 denticles which are longer distally, closely spaced in a slightly curved row, extending beyond the basal third of the siphon; hair tuft with 4–5 branches situated distal to the pecten.

Saddle of last segment extending beyond middle of sides, its posterior margin with small spines; lateral hair much longer than the saddle, with 2–3 branches; outer caudal hairs simple, thicker, longer than the siphon, inner hairs usually with 3 branches, nearly half as long. Fin with 7–10 tufts with 2–4 branches on the common base and 1–2 shorter tufts before the base. Gills sausage-shaped, slightly tapering at the ends, longer than the saddle, the lower pair shorter.

278 Larvae from northern Iran (Figure 182) differ in their smaller size, longer and more strongly branched but thinner hairs on the body, more distinct secondary feathering in their basal part, longer tufts of the fin, and shorter gills.

Distribution. Europe, to England and southern Scandinavia in the north (58°), North Africa, Southwest Asia to Iran. West and south of the USSR: Lithuania, Belorussia, Ukraine, Caucasus. Single specimens have been recorded from Turkmenia, Chuvash, Kuibyshev Region, Voronezh.

Biology. The larvae develop in tree holes (beech, oak, walnut, poplar, ash) and in strongly shaded (tree holes) and well illuminated waters (tree stumps). They sometimes develop in pools, puddles, etc. together with larvae of A. plumbeus, A. pulchritarsis and Orthopodomyia. Hibernation in the egg stage in the north, as larvae in the south, so that adult mosquitoes may appear in warm winters. Large numbers are found in broadleaved forests with abundant summer rains and warm winters. They are rarely found in mixed forests and still more rarely in conifer forests. In forests in the Carpathians, Caucasus and Talysh they are mass bloodsuckers and the predominant species. Rare in other areas of the USSR. They attack mainly in the open, rarely entering inhabited areas. They appear later in spring than most other species of Aedes, as they depend on summer rains. They are usually most numerous in midsummer.

Transmission of yellow fever by A. geniculatus has been proved experimentally, but the species does not occur in foci of yellow fever.

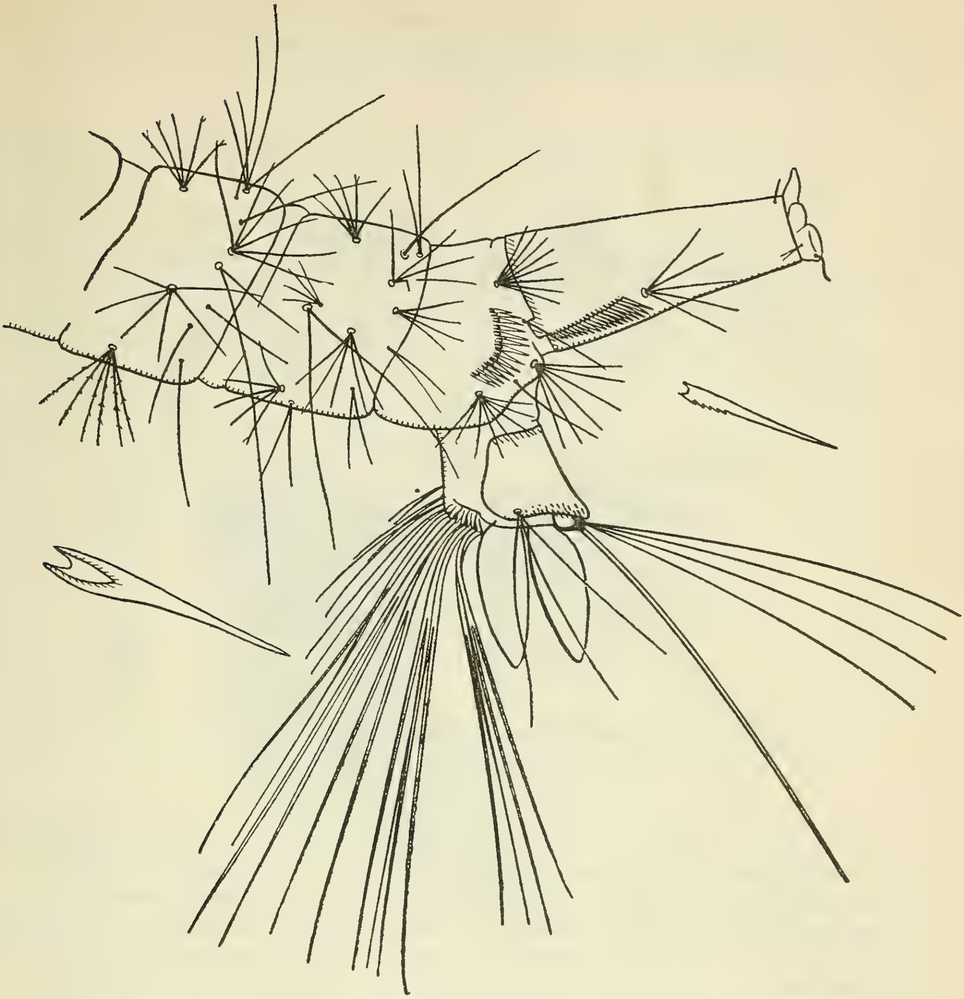

FIGURE 182. Aedes geniculatus Ol. from Northern Iran. Fourth-stage larva. Posterior end, lateral.

35. Aedes (Finlaya) echinus Edwards, 1920

Closely related to A. geniculatus, but differs in the coloration of the thorax and particularly in the coloration and form of the scales on the scutellum.

Proboscis and palps with black scales. Mesonotum with 2 approximate chestnut-brown longitudinal stripes, distinctly bordered laterally by white scales. Scutellum with broad, white scales. Pleurae of thorax with spots of white scales, distinct against the dark background of the integument. Femora with a small white spot at the apex; tibiae and tarsi black. Wings with dark scales. Abdomen dark dorsally, with narrow, whitish stripes at the base of the tergites which widen laterally into triangular, white spots.

There are apparently no distinct differences from A. geniculatus in the structure of the hypopygium. However, the coxite is covered with very long, dense hairs in A. echinus.

(279)

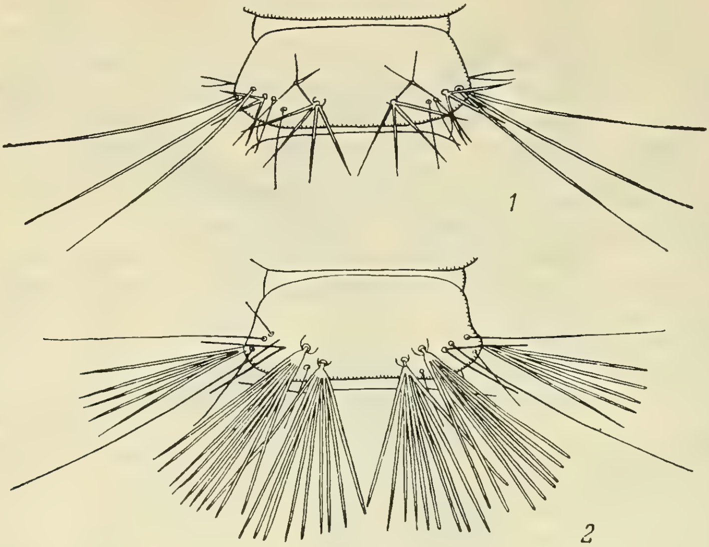

FIGURE 183. First abdominal segment, dorsal (after Edwards):

1 – Aedes geniculatus Ol.; 2 – Aedes echinus Edw.

Fourth-stage larva. (Figures 183 and 184) distinguished by the unusually strong development of the thoracic and abdominal hairs, which are stellately branched from the base into thick spines with secondary feathering, so that the larvae have the appearance of a hedghog. The description is based on material from Bulgaria which was kindly provided by D. K. Bozhkov.

Frontal hairs long, without secondary feathering: outer hairs with 2–4 (usually 3) branches, median hairs with 1–2 branches, situated before the inner hairs, which are always simple; postclypeal hairs with 7–10 (usually 279 7) thinner and shorter branches divided from the base. Antenna long (0.60–0.75 of the length of the head), distinctly curved, without spines, with a simple, rarely 2-branched hair situated at $^3/_5$ of the length of the antenna from the base; the hair is sometimes divided into 2–3 branches at the apex.

Comb with 12–18 (usually 14) elongate scales in a slightly posteriorly curved row; scales with a strongly developed main spine and with small spines from the apex or from below it at the margin which are shorter basally. Siphon nearly cylindrical, index 3.0–3.5 or slightly more, with distinct auricles at the base. Pecten with 15–27 (usually 18–22) closely spaced, long, spiniform denticles which are shorter toward the base and 2–4 rudimentary denticles near the base; at the base of each denticle is a larger spine and several smaller spines; the pecten extends beyond the middle of the siphon. Hair tuft situated distal to the pecten, with 2–4 (usually 3) branches which are distinctly longer than the width of the siphon.

(280)

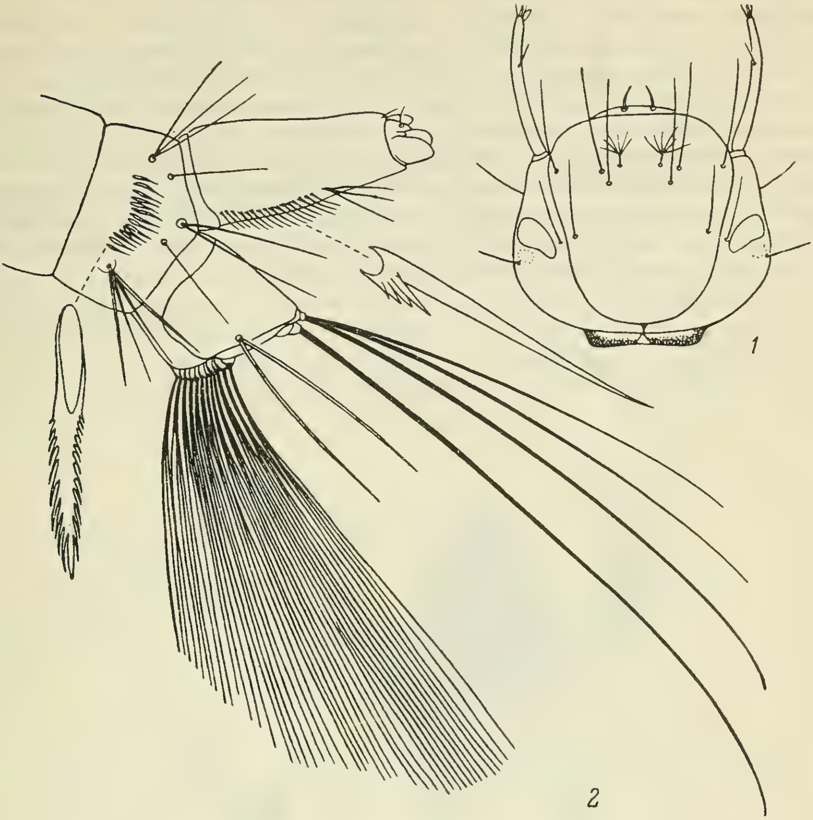

FIGURE 184. *Aedes echinus* Edw. Fourth-stage larva (after Edwards):
1 – head, dorsal; 2 – posterior end, lateral.

Saddle of last segment nearly reaching lower margin of sides; lateral hair with 2 thick branches, longer than the saddle; outer caudal hairs simple, more than twice as long as the siphon, inner hairs with 3 (rarely 2) shorter branches. Fin with 9–13 tufts with 2–3 branches on the common base and 1–2 tufts before the base. Gills strongly developed, upper pair 3–4 times and lower pair 1.5 times as long as the saddle.

Distribution. Mediterranean: North Africa, Asia Minor, Southern Europe including the Balkans. It occurs in Bulgaria (Bozhkov, 1966) but not in the USSR.

Biology. The biology of the larvae has been little studied, but it apparently resembles that of *A. geniculatus*. The larvae have been
280 found in Anatolia in root holes of olive trees which fill with water during spring floods. They are numerous on the Black Sea coast of Bulgaria.

36. Aedes (Finlaya) **nipponicus** La Casse and Yamaguti, 1948

Resembling the two preceding species, but differing in the absence of white rings on the tarsi. It differs from the other Palaearctic species with dark tarsi in the presence of white spots on the mesonotum. Previously known as A. niveus Ludlow, 1903. The new subspecies A. niveus nipponicus La Casse and Yamaguti, 1948 was described from Japan and the authors considered it as a different species. It belongs to the geniculatus group, but the subgroup niveus is represented by a large number of species in the Oriental region (Colless, 1958). The differences between the species are apparently very small. In particular, the characters distinguishing A. niveus and A. nipponicus (see below) do not justify considering A. nipponicus as a distinct species.

281

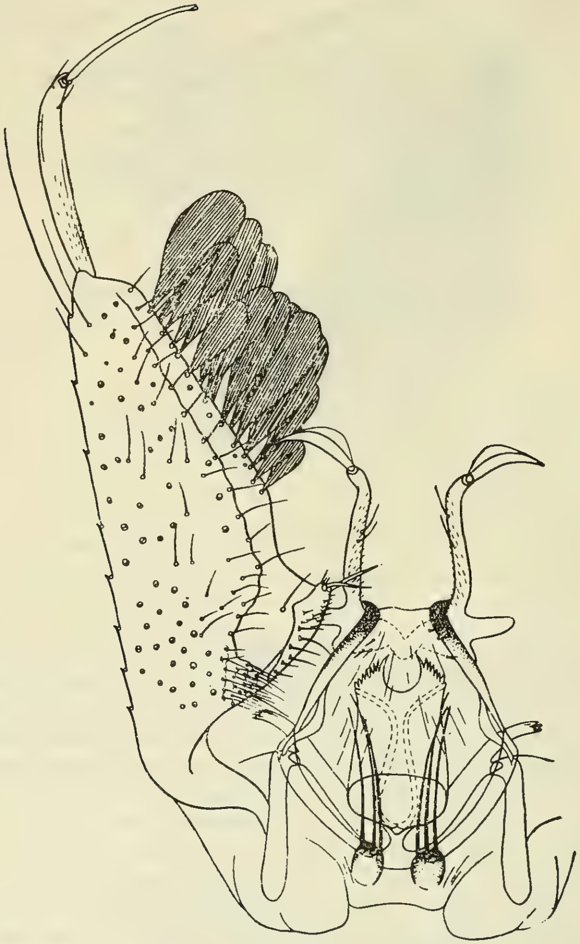

FIGURE 185. Hypopygium of Aedes nipponicus La Casse and Yamag. (after La Casse and Yamaguti)

Proboscis and palps with brown scales. Mesonotum with 2 large spots of silvery white scales divided in the middle by a dark longitudinal stripe which is wider posteriorly. Scutellum with light scales. Wings and tarsi with brown scales. Abdomen with brown scales dorsally and white spots at the sides of the segments, sometimes connected by narrow white stripes at the base of the tergites; the stripes are usually present on the posterior segments. Spermatheca single (La Casse and Yamaguti, 1955), which is an exception; there are usually 3 spermathecae in species of Aedes.

Aedes nipponicus differs from A. niveus in that "the white spots of the mesonotum are nearly always (but there are exceptions) bordered on the medial side by a concave line" (La Casse and Yamaguti, 1955). The coloration of the mesonotum in specimens from the Maritime Territory is very variable. The dark, longitudinal stripe dividing the white spots usually extends to the anterior margin of the mesonotum while the line separating the light and dark parts may be straight or (usually) slightly concave. The dark stripe often does not reach the anterior margin of the mesonotum and the white spots are connected. Sometimes, especially in males, the entire anterior half of the mesonotum is covered with silvery scales.

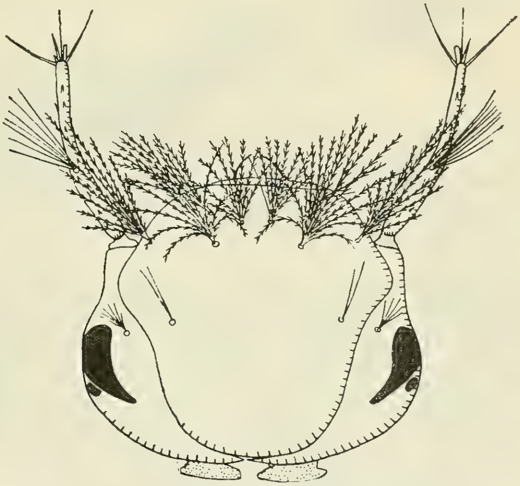

FIGURE 186. Aedes nipponicus La Casse and Yamag. Fourth-stage larva. Head, dorsal.

Hypopygium very characteristic (Figure 185). Not only is the outer surface of the coxite covered with scales, as in the other species of Finlaya, but there is also a group of large scales on the inner surface, Basal lobe weakly developed, with 2 short setae. At the base of the coxite
282 is a tuft of dense, short hairs. Style with a long appendage about $^3/_4$ as long as the style. Lobes of tergite 9 situated close together, with several thin, long setae.

Fourth-stage larva (Figures 186 and 187), as in all species living in tree holes, of varying size, greenish gray or grayish brown, with dark head and siphon.

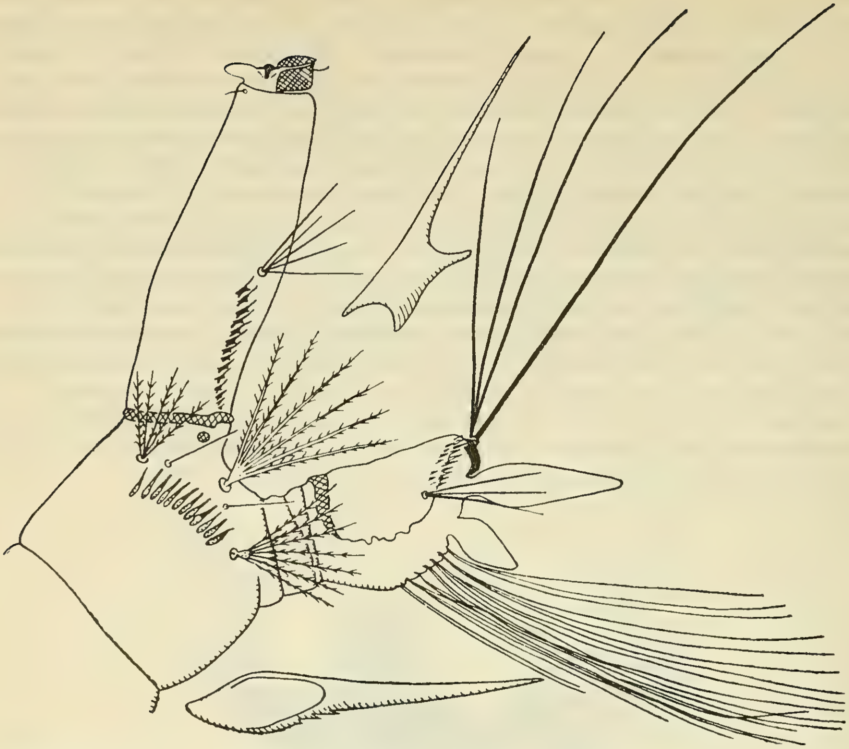

FIGURE 187. Aedes nipponicus La Casse and Yamag. Fourth-stage larva. Posterior end, lateral.

Frontal hairs displaced toward anterior margin of head, secondarily feathered, central branches longer than lateral branches; the outer hairs are the longest, with 6–16 (usually 9–12) branches, median hairs with 7–12 (usually 9–10) and inner hairs with 8–18 (usually 9–12) branches. Postclypeal hairs strongly developed, resembling the median hairs, situated between them and with 6–12 (usually 9–11) branches. Antenna long (0.6–0.65 of the length of the head), thin, covered with small spines, hair tuft with 5–11 (usually 6–9) branches, half as long as the antenna.

Comb with 8–15 (usually 10–12) scales in one row, scales with a pointed main spine and with a few small setae at the margin at the base. Siphon slightly S-curved, index 2.5–3.8, usually about 3, with weakly developed auricles at the base. Pecten with 10–24 (usually 16–18) denticles and 1–5 (usually 2) small denticles at the base, all denticles equally spaced, the distal denticle not larger than the others, denticles with a large accessory denticle and several small setae at the wide base. Hair tuft with 3–7 (usually 4–6) secondarily feathered branches, stellate.

283 Saddle of last segment extending beyond middle of sides, with dark anterior margin and with spines at the posterior margin; lateral hair with 1–5 (usually 2–4) branches; outer caudal hairs thick, simple, inner hairs with 2–5 (usually 3–4) branches, the ventral branch the longest. Fin

with 5–8 (usually 6) tufts with 2–3 branches and 1–2 shorter anterior tufts, the tufts not situated on a common base. Gills lanceolate, upper pair usually longer than the saddle, lower pair less than half as long.

Distribution. Japan, Korea, North China. Only in the extreme south of the Maritime Territory in the USSR.

Biology. The larvae develop almost always in tree holes and in stumps, in small water bodies, in stems of bamboo in the south. They are often found in holes of linden (Tilia amurensis) and maple (Acer mono and A. manshuricum), rarely in birch (Betula ermani and B. dahurica), holes of Phellodendron, Manchurian walnut and Siberian stone pine. Larvae have been found in roots and tree holes to 8 m high together with larvae of A. galloisi, A. alektorovi and Toxorhynchites sp. Hibernation in the egg stage. The larvae appear in early June. The larval stages last 20–25 days, pupation 4 days. Flight of the first summer generation begins in early July. There may be 4 generations per year.

The females are bloodsuckers and attack man in large numbers. They fly from the breeding place for a distance of 1 km. They are active throughout the day in forests. Their numbers markedly decrease toward autumn. They also bite inside buildings.

37. Aedes (Finlaya) seoulensis Yamada, 1921

The species is characterized by a white spot on the mesonotum and white rings on the tarsi.

Proboscis and palps with black scales. Mesonotum with narrow, white scales in the anterior half, with dark brown scales in the posterior half. Posterior border of part with white scales curved. The area without scales before the scutellum is bordered by white scales. Scutellum with white scales. Tarsi with white rings on the first three segments, rings extending to apex of one segment and base of next. Rings on fore tarsi present only on the first two segments. Wings with brown scales, with a spot of light scales at the base of the costa. Abdomen with black scales with a steel sheen dorsally; narrow whitish stripes at anterior margin of tergites, white spots at the sides; light scales at posterior margin of tergites on the last segments.

Hypopygium: coxite with scales on the outer surface. Appendage of style about $^1/_4$ as long as the style. Claspettes with short stem and narrow wing, wing slightly longer than the stem. Lobes of tergite 9 with 6–8 hairs.

The fourth-stage larva has not been described in detail (Feng, 1938). Frontal hairs not displaced toward the anterior margin, median hairs situated before the inner, all three pairs, especially the outer and median, long, with about 5 branches. Postclypeal hairs not shorter than the median hairs, branched, situated between the median and inner hairs but closer together. Sutural hair simple, long, not shorter than the frontal hairs. Antenna slightly more than half as long as the head, with sparse
284 spines and a simple or 2-branched hair in the middle, slightly distal to it, its end reaching the apex.

Comb with 55–60 closely spaced scales with a main spine and with thin setae from the base to $^2/_3$ of its length. Siphon straight, index 3.0. Pecten with 20–22 long, equally spaced denticles, the distal denticle situated beyond the middle of the siphon. Hair tuft with 5–6 branches situated in the apical part.

Last segment very long, saddle reaching to middle of sides; lateral hair simple; outer caudal hairs simple, more than 1.5 times as long as the siphon, inner hairs with 6 shorter branches. Fin with 10 tufts on the common base. Gills sausage-shaped, upper pair 1.3 times as long as the siphon, lower pair 0.75 times as long.

Distribution. Korea, North and Northwest China. Not recorded from the USSR.

Biology. The larvae usually develop in tree holes (Ulmus pumila, Quercus acutissima and Sophora japonica) during the summer.

38. Aedes (Finlaya) alektorovi Stackelberg, 1943

The species differs from the two preceding species in the absence of a white spot on the mesonotum; tarsi with narrow white rings but not on all segments (Stackelberg, 1943).

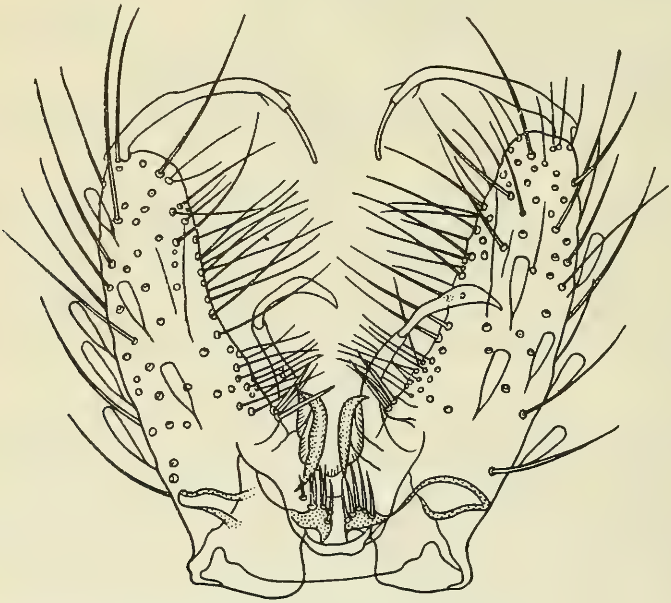

FIGURE 188. Hypopygium of Aedes alektorovi Stack.

Proboscis and palps with dark scales. Palps of male as long as the proboscis or slightly shorter. Mesonotum with scales of 2 colors: chestnut brown scales provide the background for the golden scales, which form

stripes and spots. The golden scales sometimes predominate, especially in males. Tarsi of fore and mid-legs (or only fore tarsi) dark, except for
285 a small white spot at the articulation of tibia and tarsus. Hind tarsi (sometimes also mid-tarsi) with 2, 3 or 4 narrow white rings, which extend to the apex of one segment and the base of the next. Wings with dark scales. Abdomen dark, with white spots at the sides, sometimes connected by narrow, white stripes at the base of the tergites. Cerci hardly visible.

Hypopygium (Figure 188): basal lobe of coxite forming a small tubercle with 2 large, curved setae and 1 (or 2) thinner seta. Appendage of style about $^1/_4$ as long as the style. Stem of claspette longer than the wing, slightly which is slightly curved in the middle, slightly wider in the apical half. Lobes of tergite 9 with 3–6 setae.

(286)

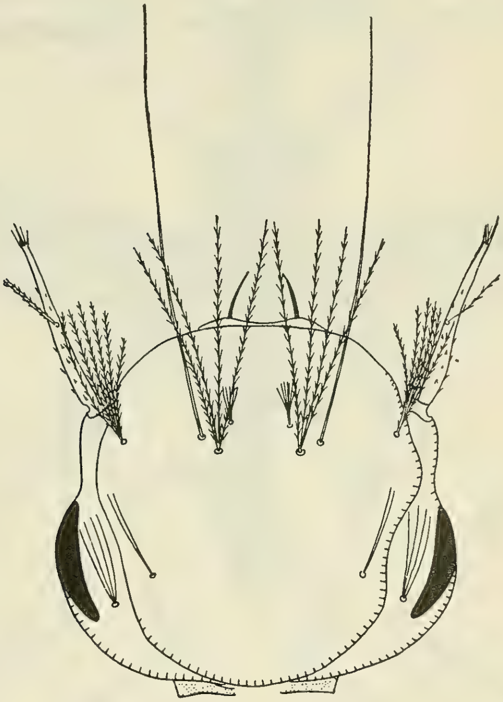

FIGURE 189. Aedes alektorovi Stack. Fourth-stage larva. Head, dorsal.

Fourth-stage larva (Figures 189–191) of varying size, depending on the size of the tree hole and its population, light brown with darker head and especially dark siphon (Monchadskii, 1949). Frontal hairs: outer hairs with 4–8 (usually 6) secondarily feathered branches, median hairs simple, smooth, very long, about 1.25 times as long as the head, inner hairs situated behind the median hairs, with 3–5 secondarily feathered branches, half as long as the median hairs. Postclypeal hairs situated before the median hairs

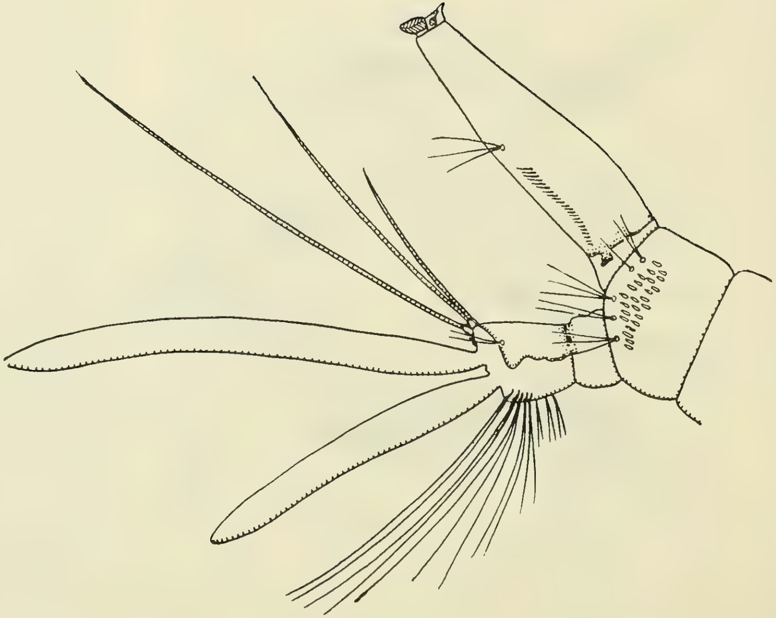

FIGURE 190. Aedes alektorovi Stack. Fourth-stage larva. Posterior end, lateral.

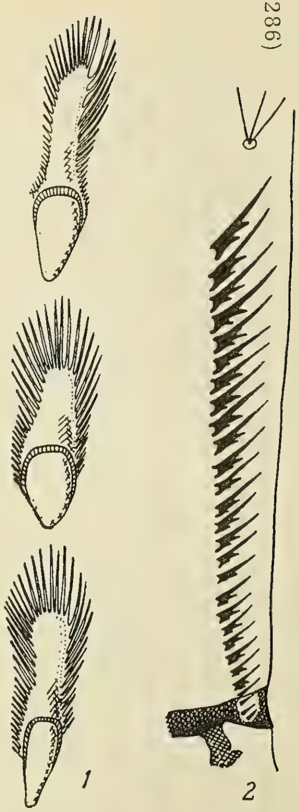

FIGURE 191. Aedes alektorovi Stack. Fourth-stage larva:

1 – scales of comb; 2 – pecten.

(287)

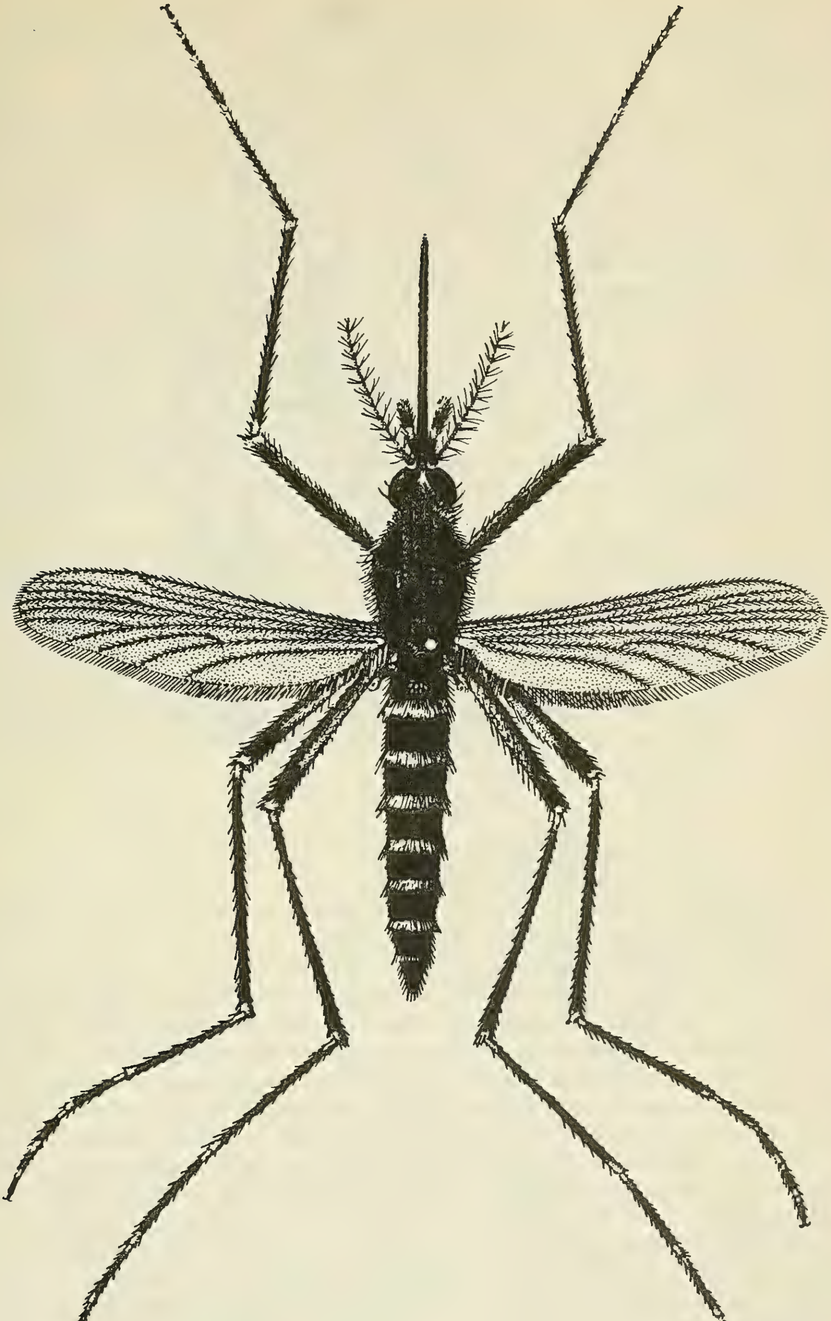

FIGURE 192. Aedes togoi Theob.

closer together, with 10–12 short, thin branches. Antenna about half as long as the head, with a few spines, hair tuft with 1–2 branches situated in the middle.

Hairs of body very long, especially the lateral abdominal hairs. Comb with 20–41 (usually 25–30) scales without a main spine, in 2–3 rows, with a row of spines which are shorter toward the base at the margin. Siphon thin, slightly curved, index 3.9–4.5. Pecten not reaching middle of siphon, with 19–27 (usually 21–24) denticles and 1–3 rudimentary, closely spaced denticles near the base; denticles longer distally. Hair tuft with 3–4 branches situated in the middle, as long as the width of the siphon.

Saddle of last segment not reaching middle of sides; lateral hair short, with 2–4 (usually 3) thin branches; outer caudal hairs nearly 1.5 times as long as the siphon, simple, inner hairs with 2–3 shorter branches. Fin weakly developed, lateral processes of base not forming a common base, with 4–7 (usually 5–6) tufts, with lateral processes at the base and 3–4 shorter tufts anteriorly. Gills 1.5 times as long as the siphon, sausage-shaped, slightly pointed, lower pair 15–25% shorter than upper pair.

Distribution. It occurs in several localities in the Far East, south of Khabarovsk.

Biology. A rare species characteristic for the broadleaved forests of the Maritime Territory. The larvae develop only in tree holes (Tilia amurensis; Acer mono, A. manshuricum and A. pseudosieboldianum; Betula ermani and B. dahurica; Phellodendron amurense, and others) together with larvae of A. galloisi, A. nipponicus and Toxorhynchites christophi. They usually develop in tree holes with narrow openings and choose the darkest places, avoiding roots in the open. Hibernation in the egg stage. Development in July lasts about 15 days.

288 39. Aedes (Finlaya) togoi Theobald, 1907

The species is characterized by white rings on the tarsi of all legs, the rings extending to two segments (Figure 192).

Proboscis with dark scales. Palps of female with black scales and with white apex. Palps of male about $^4/_5$ as long as the proboscis, black, with white rings at the articulations. Mesonotum with blackish brown scales and weak, narrow longitudinal stripes of yellowish white scales in the midline along the dorsocentral setae at the lateral margins of the mesonotum. Scutellum and a small area before it with yellowish white scales. Tarsi black, with narrow white rings on the apex of one segment and base of the next. Wings with brown scales. Abdomen with black scales, with triangular white spots on the sides, connected by narrow stripes at the base of the tergites.

Hypopygium (Figure 193) with a characteristic structure of the claspettes: the narrow wings are distinctly longer than the stem. Coxite with long, slightly flattened, longitudinally striated setae dorsally and on the inside. Numerous scales on the outer surface of the coxite, sometimes isolated scales also on the inner surface. Appendage of style short. Lobes of tergite 9 with 6–9 thin hairs.

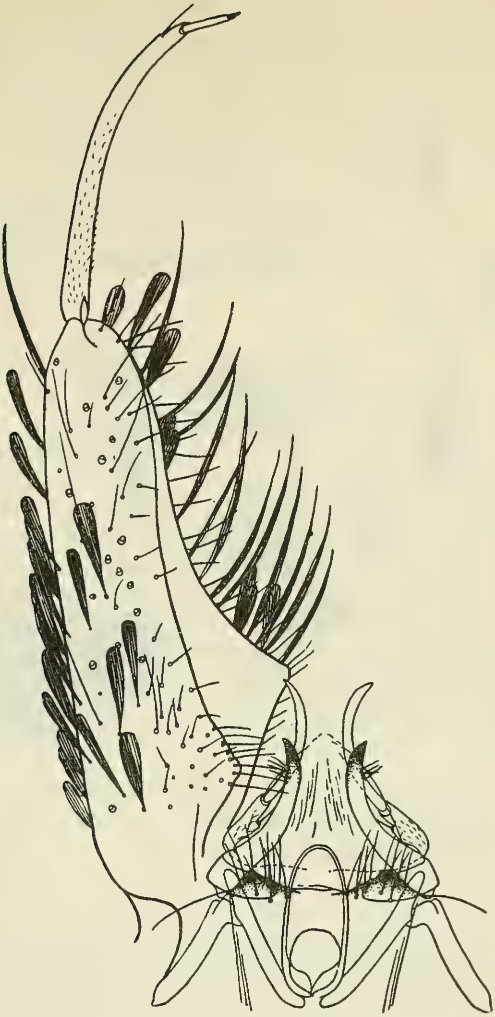

FIGURE 193. Hypopygium of Aedes togoi Theob. (after La Casse and Yamaguti)

Fourth-stage larva (Figure 194) medium-sized to large, with weakly colored body, dark head and lighter siphon.

Frontal hairs displaced toward anterior margin of head and arranged in a curved row which is convex anteriorly; outer hairs with 6–7, the longer median hairs with 7–8 and the inner hairs with 11–13 branches forming fans. Postclypeal hairs situated between the inner hairs, usually with 7 shorter branches. Antenna nearly straight, short, irregularly covered with sparse spines and with a short hair with 2–3 branches.

Comb with 80–125 closely arranged scales of varying size, with rounded end and with a row of spines at the margin which are shorter near the base.

289 Siphon short (index 1.8–2.3), slightly barrel-shaped. Pecten extending distinctly beyond middle of siphon, with 18–25 closely spaced, spinelike denticles which are shorter near the base; at the lower margin of each denticle are 2–5 widely spaced accessory denticles. Hair tuft with 7–10 secondarily feathered branches, forming a fan, situated near the apex, longer than the width of the siphon.

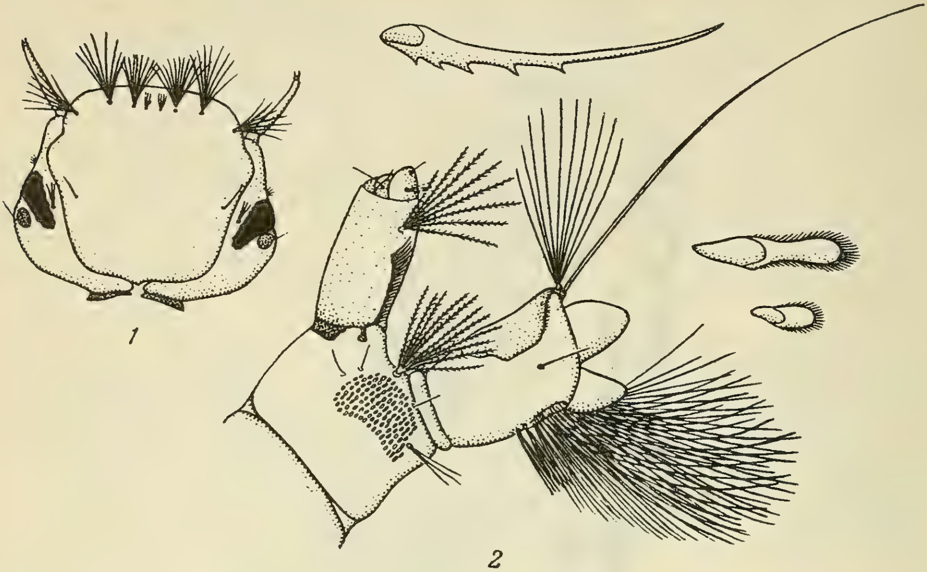

FIGURE 194. Aedes togoi Theob. Fourth-stage larva:
1 – head, dorsal; 2 – posterior end, lateral.

Last segment as long as the siphon, with a small saddle, which almost does not reach the sides; lateral hair short, simple; outer caudal hairs simple, usually 2.5 times as long as the siphon, inner hairs half as long, forming a fan with 9–11 branches. Fin with 1–14 tufts with 7–12 branches, and 1–2 shorter tufts before the common base. Gills irregularly leaf-shaped, $^2/_5 - ^1/_3$ as long as the last segment.

Distribution. Coastal belt of China, Korea and Japan, including Hokkaido. It occurs in the USSR in the southern part of the Maritime Territory, Sakhalin and on the southern Kurile Islands.

Biology. The larvae occur in large numbers in small pools on rocky coasts near the surf zone where the water is often very salty, with marked fluctuations because of rain, breakers or drying, which they tolerate. They are sometimes found together with larvae of C. vagans and A. hyrcanus. Several generations per year, from May to October. Secondary biotopes are stone basins, reservoirs or other artificial water bodies in inhabited areas, sometimes far from the coast, for example in Peking.

They are mass bloodsuckers in some localities, attacking in the open 290 and in inhabited areas. In sparsely populated areas they apparently feed mainly on sea birds. In the Maritime Territory adult mosquitoes are found from June to the end of October, mass flight from the middle of July to early September.

Epidemiological importance. This species is of great importance because it transmits Japanese encephalitis. Transmission of the virus was proved experimentally and natural infections were found. In China, A. togoi is an intermediate host of Brugia malayi (an important vector) and Wuchereria bancrofti (vector of minor importance).

40. Aedes (Finlaya) japonicus Theobald, 1901

In contrast to A. togoi, A. japonicus has white rings only at the base of the tarsal segments.

Proboscis and palps with black scales. Mesonotum with blackish brown scales, with 3 longitudinal stripes of light yellowish scales in the anterior half in the midline and along the dorsocentral setae; at the sides of the posterior half of the mesonotum are two curved, light stripes. Scutellum and area before it with yellowish white scales. Area below the anterior spiracle without scales. Tarsi with narrow, white rings at the base of the first two segments (fore tarsi) or first three segments (mid- and hind tarsi). Wings with dark scales. Abdomen with black scales dorsally, with small, white, triangular spots at the sides; usually narrow, transverse, white stripes at the base of the tergites which are usually not connected with the lateral spots.

Hypopygium: coxite with scales on the outer surface and moderately long hairs. Stem of claspette longer than wing or as long as this. Lobes of tergite 9 small, flattened, with 4–9 thin hairs, sclerotized claws at apex of sternite 10 bifurcate.

Fourth-stage larva medium-sized to large. Frontal hairs smooth, displaced toward anterior margin of head and arranged in a curved row which is convex anteriorly; outer hairs with 4–7, median hairs with 3–6, inner hairs with 4–7 branches. Postclypeal hairs very short, situated between the inner hairs, with 2–5 thin branches. Antenna less than half as long as the head, with sparse spines, hair tuft with 2–3 short branches situated beyond the middle.

Comb with 43–85 closely spaced scales without a main spine, with a row of marginal spines which are longest at the rounded distal margin. Siphon straight, tapering from the tuft, index 2.3–3.8. Pecten with 14–29 denticles extending distinctly beyond middle of siphon, 1–4 of the distal denticles forming a more pointed angle to the longitudinal axis of the siphon in the form of larger, more widely spaced spines. Hair tuft with 4–7 secondarily feathered branches, as long as the width of the siphon, situated distal to its middle.

Saddle of last segment covering the sides to the middle, its posterior margin with spines of different size; lateral hair with 1–2 branches, about as long as the last segment; outer caudal hairs more than 1.5 times as

long as the siphon, inner hairs with 2–4 branches about $^1/_3$ shorter. Fin
291 with tufts with 2–5 branches on the common base. Gills lanceolate, usually 1.5 times as long as the saddle.

Distribution. China, Japan (Hokkaido). Not recorded from the USSR.

Biology. This is a common and widespread species in Japan which occurs in mountains to an altitude of 1,300 m. The larvae occur in artificial water bodies with abundant decomposing organic matter in sunlight and in the shade. They occur in large numbers in spring and autumn. Their numbers remain the same from May to October in the south of Japan. They apparently rarely attack people.

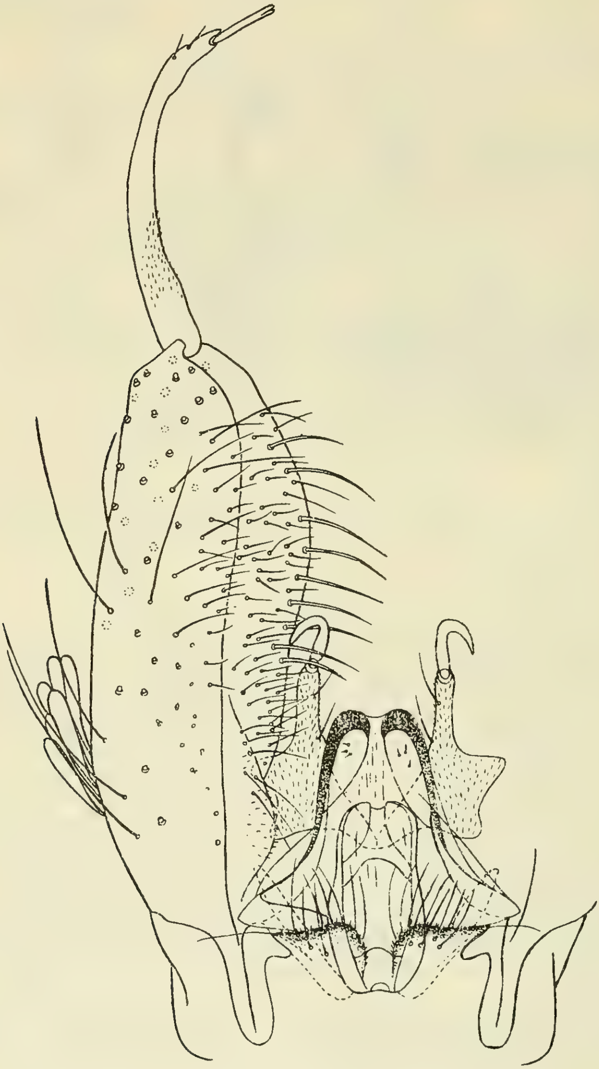

FIGURE 195. Hypopygium of Aedes koreicus Edw. (after La Casse and Yamaguti)

41. Aedes (Finlaya) koreicus Edwards, 1917
(japonicus var. koreicus Edwards)

Closely related to A. japonicus, and was previously not distinguished from it or regarded as a subspecies. In the Soviet literature on mosquitoes of the Maritime Territory and on vectors of Japanese encephalitis, it was named A. japonicus.

Proboscis and palps with black scales. Mesonotum with dark scales and light stripes, as in A. japonicus, but stripes narrower. Area below anterior spiracle with a stripe of broad, white scales. Tarsi with narrow, white rings at the base of the segments. Rings on fore tarsi present on the first two segments, on the mid-tarsi on 3 or 4 segments, on the hind tarsi on 4 segments, last segment dark. Wings with dark scales. Abdomen dark dorsally, with narrow, transverse, light stripes at the base of the segments. Stripes not connected with the lateral white spots, which are usually not visible dorsally except on the 8th tergite.

292 Hypopygium (Figure 195) resembling that of A. japonicus with the following differences: lobes of tergite 9 hemispherical; claws at apex of sternite 10 simple.

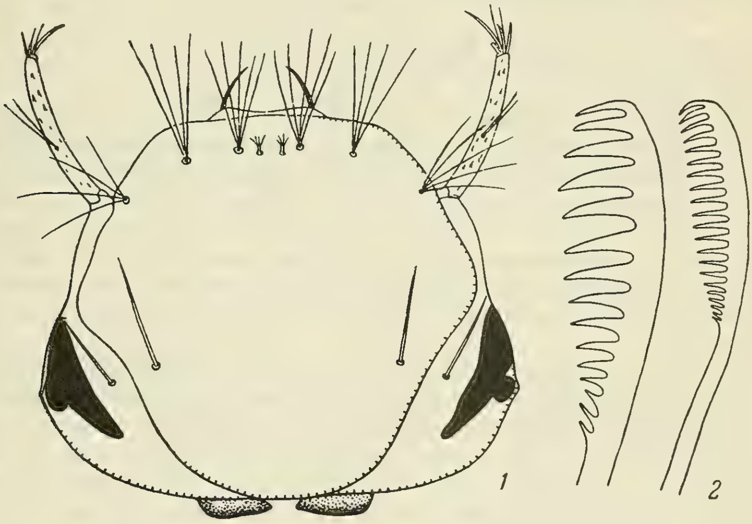

FIGURE 196. Aedes koreicus Edw. Fourth-stage larva:
1 – head, dorsal; 2 – ends of hairs of labrum.

Fourth-stage larva (Figures 196 and 197) large, often darkly
pigmented. Frontal hairs without secondary feathering, displaced toward
anterior margin of head and arranged in an anteriorly curved row; outer
hairs shorter, with 3–6 (usually 4–5) branches, median hairs with 2–6
293 (usually 3–5), inner hairs with 4–6 (usually 5–6) branches. Postclypeal
hairs short, with 2–4 thin branches from middle of stem. Antenna less
than half as long as the head, irregularly covered with sparse spines and
a short tuft with 1–4 (usually 2–3) short branches.

(292)

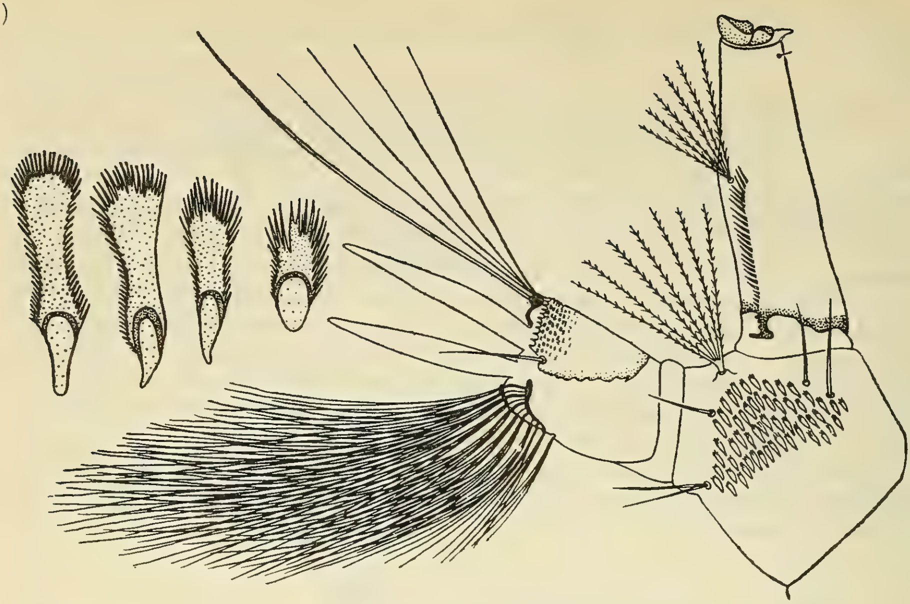

FIGURE 197. Aedes koreicus Edw. Fourth-stage larva. Posterior end, lateral.

Comb with 49–70 (average 58) densely arranged scales of varying size and form, without a main spine, with a row of spines at the margin which are longer at the apex. Siphon distinctly tapering from the hair tuft, index 2.8–3.4 (average 3.1). Pecten about half as long as the siphon or slightly longer, with 18–27 (often 20–25) densely arranged denticles, the distal denticles larger and forming a more pointed angle with the longitudinal axis of the siphon; the hair tuft is situated at the position of these denticles, forming a fan with 4–7 secondarily feathered branches, a third as long as the siphon.

Saddle of last segment small, with irregularly jagged lateral margin, extending to dorsal third of sides and with small and larger spines at the posterior margin; lateral hair simple, rarely 2-branched; outer caudal hairs simple, 1.5 times as long as the siphon, inner hairs with 3–5 (usually 4) slightly shorter branches. Fin with 12, rarely 11, tufts on the common base and 1, rarely 2, tufts before the base. Gills lanceolate, narrow, usually 1.75 times as long as the saddle.

Distribution. Northeast China, Korea, Japan (Hokkaido). In the Maritime Territory in the USSR.

Biology. The larvae occur in large numbers in rainwater barrels which become filled during the summer, always together with C. vagans. The species is very common in forests in the Southern Maritime Territory and in inhabited areas or their vicinity. They bite in the open, sometimes in large numbers, but rarely enter houses. They bite people and farm animals and are often found in chicken coops. Adult mosquitoes are found in the Maritime Territory from June to September, mass flight from July to August. Probably two generations per year.

This species is apparently a potential vector of Japanese encephalitis. Experimental transmission of the virus has been reported.

4. Subgenus Stegomyia Theobald, 1901

Small, rarely medium-sized. Proboscis relatively thick and short, about as long as the fore femora. Palps of male slightly longer than the proboscis, with thin, usually upward curved apical segments, without hair tufts. Eighth sternite of female well developed, cerci short.

Hypopygium: claspettes absent, basal (or subapical) lobe of coxite well developed, apical lobe absent, aedeagus divided into two plates, with small denticles at the apex in most species.

Coloration characteristic: mesonotum with a pattern of light scales, tarsi with white rings at the base of the segments. Light spots on head, scutellum, pleurae of thorax and abdomen formed mainly by white scales with a silvery sheen.

294 We give the characters of coloration common to the species of Stegomyia described below. Proboscis with dark scales. Palps of female dark in the basal half, white in the apical half; palps of male with white rings. Head with dark and light scales dorsally, usually forming a longitudinal stripe in the middle, round spots laterally and at the posterior margin of the eyes. Mesonotum with a light pattern which is characteristic for each species. Scutellum with 3 white spots. Tarsi with white rings at the base of the segments, which are more distinct on the hind legs. Wings with dark scales, sometimes with a small group of white scales at the base of the costa. Abdominal tergites with white stripes at the base and white spots at the sides.

The frontal hairs of the larvae are not displaced toward the anterior margin of the head. Median hairs situated before the inner hairs. Antenna without spines, with a small, usually simple hair. Plate at base of lateral hairs of mesothorax and metathorax usually with a spine. Scales of comb few, usually arranged in one row. Siphon without auricles at the base.

The subgenus contains over 90 species, mainly in the Ethiopian and Oriental regions. Some species reach the southwest Palaearctic (3 species) and the southeast Palaearctic (4 species). Four of these species occur (or occurred in the past) in the USSR.

Some of these species are important vectors of virus infections, yellow fever, dengue and others.

42. Aedes (Stegomyia) aegypti Linneus, 1762
(argenteus Poiret, 1787; fasciatus Fabricius, 1805;
calopus Meigen, 1818 (Figure 198)

It differs from the other species of the subgenus in the pattern on the mesonotum (lyrelike) and structure of the hypopygium.

Characters common to all species of Stegomyia are described above. Mesonotum with dark brown scales and with 2 distinct, lateral white stripes curved in the anterior half and 2 less distinct, narrow, straight stripes near the midline. Apex of femora white, tibiae dark. Fore and mid-tarsi black with white rings at the base of the first two segments. Hind tarsi with white rings $^{1}/_{4}-{}^{1}/_{3}$ as long as the segment on the first 3 segments about $^{4}/_{5}$ as long on the 4th segment. Last segment of hind tarsi completely white. The width of the white rings varies. Claws of fore and mid-tarsi of females with a denticle, claws of hind tarsi simple. Wings densely covered with brown scales on the veins. Abdomen with blackish-brown scales dorsally, usually with a reddish or steel sheen. Narrow white stripes in anterior part of the tergites, a silvery white spot at the sides.

(295)

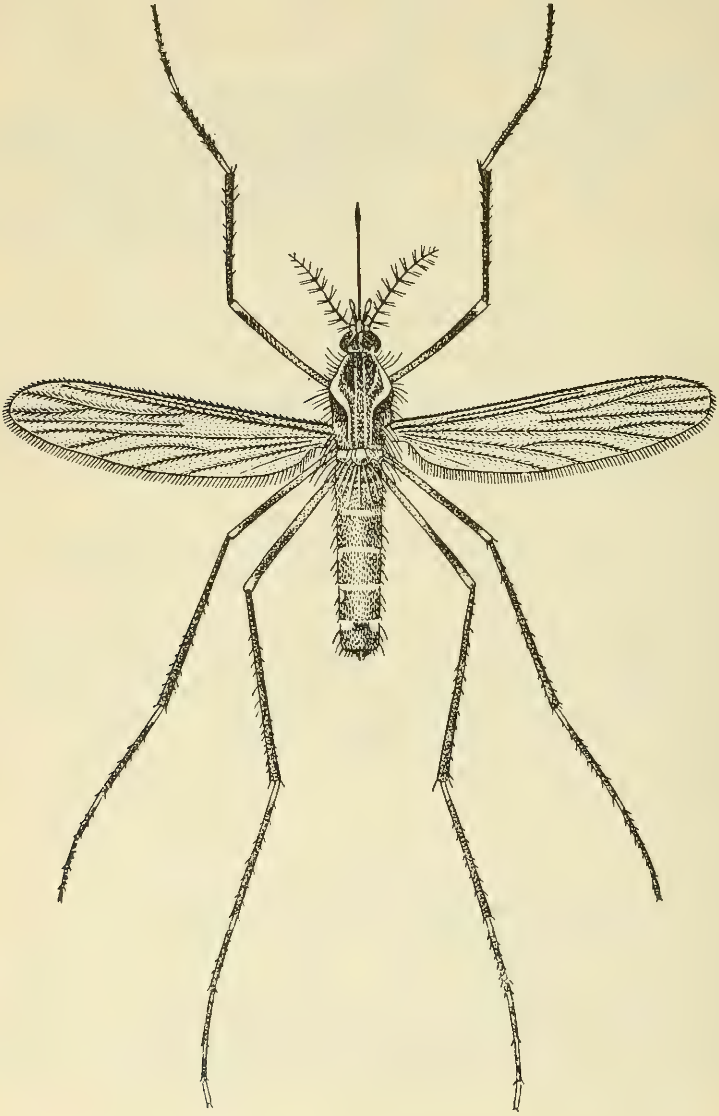

FIGURE 198. Aedes aegypti L.

(296)

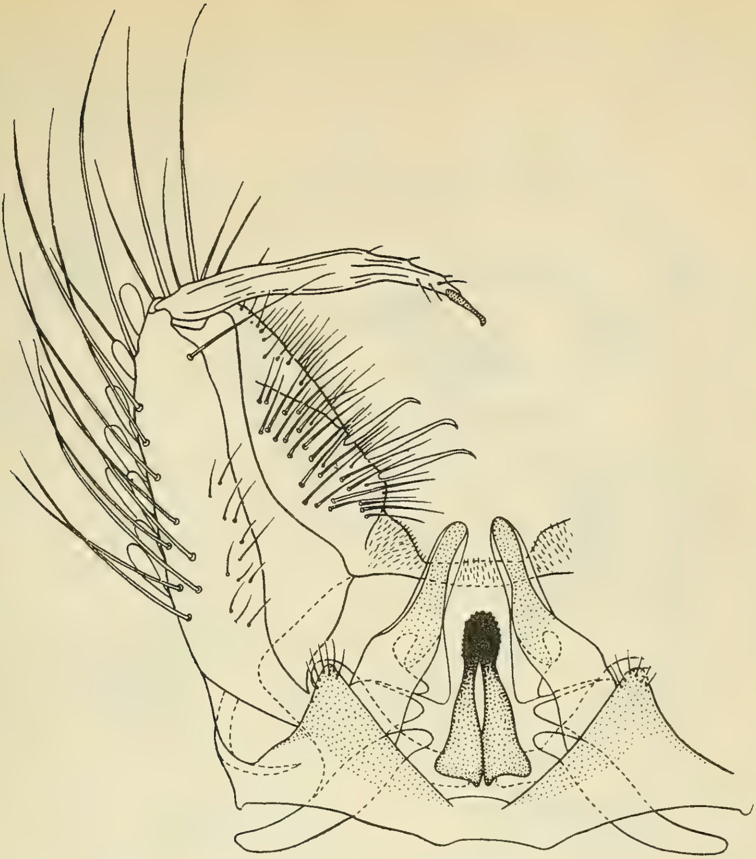

FIGURE 199. Hypopygium of Aedes aegypti L. (after Carpenter and La Casse)

Hypopygium (Figure 199): coxite short, thick, with an indistinct, flattened lobe in the middle of the inner surface, densely covered with short, seta-like hairs. Style markedly tapering apically, with a short appendage. Posterior margin of tergite 9 with a deep incision.

Fourth-stage larva (Figures 200 and 201) very variable in size and coloration, according to the conditions. Frontal hairs long, simple;
295 median hairs shorter, displaced anteriorly, inner hairs situated behind them, at the level of the outer hairs. Postclypeal hairs situated between the median hairs, with 4–6 short, thin branches. Antenna short, about half as long as the head, without spines and with a simple, short hair beyond the middle.

Comb with 8–12 (usually 10, sometimes to 18) scales in a curved row; scales variable, often with a more or less distinct main spine and usually with shorter spines at the margin which are shorter near the base. Siphon short, tapering beyond the middle (index 1.5–2.5), without auricles at the base. Pecten with 12–22 (usually 15–17) closely spaced denticles, the

296 distal denticle may be slightly more widely separated and situated beyond the middle of the siphon; denticles with broad base and a larger and 1–3 smaller accessory denticles. Hair tuft situated near the distal denticle, with 2–5 short branches.

(297)

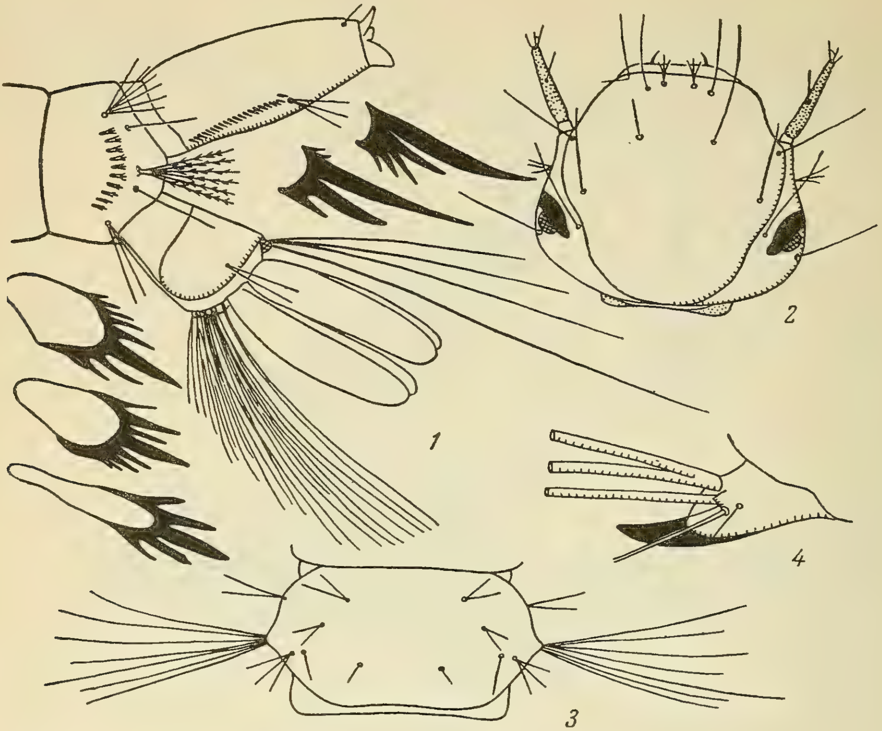

FIGURE 200. Aedes aegypti L. Fourth-stage larva (after Macfie):

1 – posterior end, lateral; 2 – head, dorsal; 3 – 2nd abdominal segment, dorsal; 4 – base of lateral hairs of metathorax.

Saddle of last segment reaching to lower margin of sides, lateral hair with 2–3 short branches; outer caudal hairs simple, twice as long as the siphon; inner hairs with 2–4 shorter branches. Fin with 8–10 tufts with 2–3 branches. Gills sausage-shaped, with rounded end, slightly shorter than the siphon.

Distribution. Tropics and subtropics of both hemispheres. Europe: France, Spain, Portugal, Italy, Yugoslavia (south of the Adriatic coast), Albania, Greece. Greater part of Africa. Asia: Southwest Asia, Iran (Shatt al-Arab), Pakistan, India, Southeast Asia, coastal parts of China (not in North and Northeast China), Japan (only in the far south). Western hemisphere: South, Central and North America, to Illinois and Indiana, i.e.
297 nearly to 40°N. However, it has now been eradicated or has become rare in many countries where it was previously common.

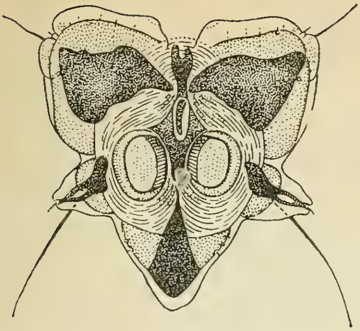

FIGURE 201. Aedes aegypti L. Fourth-stage larva. Stigmal plate.

This species used to be distributed on the Black Sea coast, from Sochi to Batumi, and often in localities far from the Black Sea, e.g. Kutaisi, Tbilisi, Baku in Transcaucasia. Because of the work instigated by N. P. Rukhadze, the incidence of A. aegypti was reduced, and it has not been found there in recent years.

Biology. The larvae develop in artificial water bodies near and in inhabited areas and tolerate strongly polluted water. Development of the larvae at 27–30° lasts about 10 days and ceases at temperatures below 20°.

The original habitat of A. aegypti is tropical Africa, where it is still found in nature. Outside this area it occurs almost exclusively in inhabited areas and is more closely connected with man than any other species. It bites mainly in houses or near them. Copulation takes place in buildings. The
298 mosquitoes copulate in small cages so that it is easy to breed them in the laboratory (at temperatures of 20–22°, optimum 25–30°). Several generations per year in nature.

The epidemiological importance of A. aegypti is very great. It is the most important or the only carrier of yellow fever outside natural foci of the disease and is therefore called the "yellow fever mosquito." Most urban foci of yellow fever have now been eradicated but if A. aegypti is present, outbreaks of the disease may occur transmitted from natural foci to inhabited areas. This species is also the main vector of dengue fever. Under experimental conditions and, possibly, under natural conditions it may transmit also other viruses infecting man, e.g. encephalitis and lymphocytic choriomeningitis. It also transmits the virus of myxomatosis of rabbits (mechanical transmission). The microfilariae of Brugia malayi develop in A. aegypti, but microfilariae of Wuchereria bancrofti usually do not reach the infective stage.

The literature on the biology of A. aegypti and its medical importance is enormous (see Horsfall, 1955). Christophers (1960) has written a large monograph on this species.

43. Aedes (Stegomyia) cretinus Edwards, 1921
(lindtropi Shingarev, 1927)

It differs from A. aegypti in the coloration of the mesonotum and the structure of the hypopygium.

299 Mesonotum with blackish brown scales, with a longitudinal white stripe in the middle and 2 small, round, white spots laterally. Coloration and claws otherwise as in A. aegypti.

Hypopygium (Figure 202): coxite oblong, the flattened process on the inner surface densely covered with hairs which are longer apically. Style narrower in the middle, with a thin, relatively long appendage situated slightly subapically. Posterior margin of tergite 9 with a curved process.

(298)

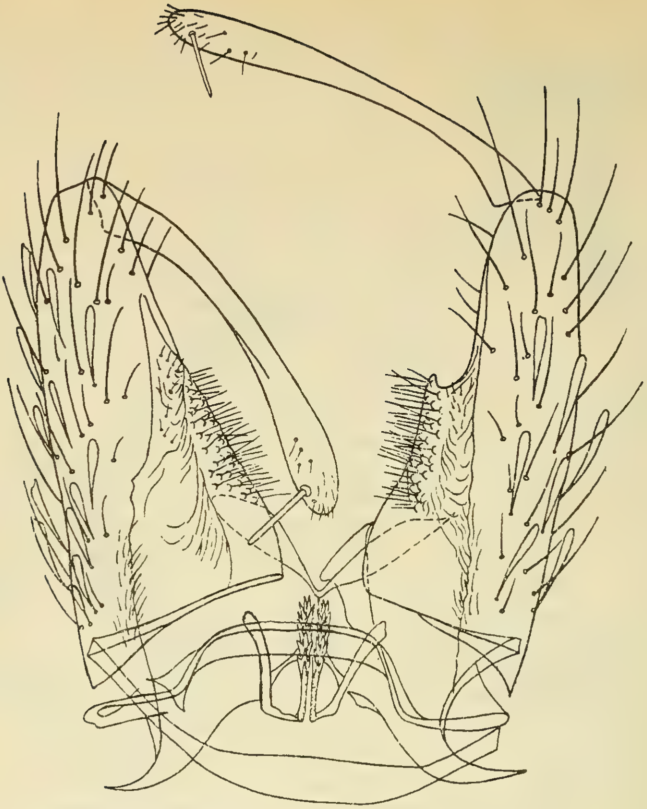

FIGURE 202. Hypopygium of Aedes cretinus Edw.

The larvae have not been described in detail. They resemble those of A. aegypti but differ from them in the thinner antennae with a simple, thick hair in the middle; comb with 10 scales in one row, with a long, pointed spine and short, thin spines at the margin near the base; index of siphon about 2.0, pecten with 11 denticles which are narrower than in A. aegypti and with smaller denticles at the base; hair tuft with 3 branches, situated in the middle of the siphon and with a simple hair on the side in the apical third; gills at most $^{2}/_{3}$ as long as the siphon, fin more strongly developed.

Distribution. Crete, Macedonia. A few specimens have been found on the Black Sea coast of the Caucasus: Sukhumi, Gudauta, Sochi (Bashkareva, 1931). The last record was by Gul'ripsh (near Sukhumi), who caught two females biting in a bamboo grove on 20 August 1939 (collection of T. Ya. Avdeeva). Two badly preserved specimens of Stegomyia from the southern coast of the Crimea probably belong to this species.

Biology not studied. The larvae were found in tree holes together with larvae of A. plumbeus, O. pulchripalpis and A. geniculatus.

44. Aedes (Stegomyia) vittatus Bigot, 1861

It differs in the coloration of the mesonotum and in the presence of a white ring on the tibiae.

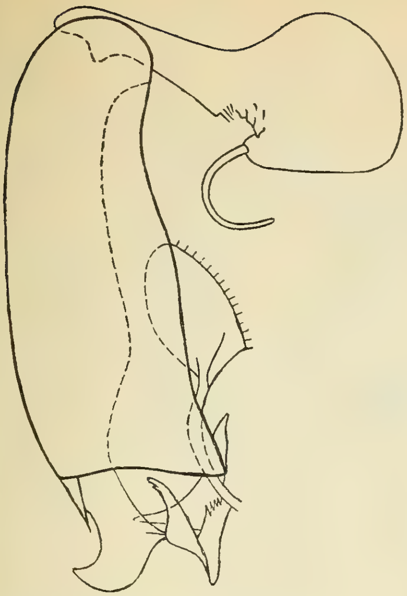

FIGURE 203. Hypopygium of Aedes vittatus Big.

Head and its appendages as in A. aegypti. Mesonotum with blackish brown scales and with 4 silvery white, round spots in the middle. Tibiae of all legs with a white ring in the middle. Tarsi with white rings at the base of the first 3 segments; rings on fore and mid-tarsi narrow, wide on the hind tarsi. Last 2 segments of hind tarsi white, sometimes dark at the apex.

Hypopygium (Figure 203) with a very characteristic style, which is markedly widened apically and has a long, curved appendage in the middle of the inner side of the style.

Fourth-stage larve (Figure 204): frontal hairs long, outer hairs with 3–6 branches, directed laterally, median hairs situated before the inner, both pairs simple. Postclypeal hairs situated between the median hairs, small, branched. Antenna slighty more than half as long as the head, with weakly developed spines and a small hair with 3 branches in the middle.
300 Comb with 6–9 (usually 8) large scales with a long, pointed main spine and a few thin, short spines at the margin, near the base. Siphon short (index 2.0 or slightly more), slightly tapering, without auricles at the base. Pecten with 20–34 spinelike denticles, occupying about $^2/_3$ of the siphon; there is also a larger, smooth spine nearer to the apex. Between this spine and the most distal denticle of the pecten is a tuft with 3–6 branches as long as the width of the siphon at its position.

Last segment longer than in other larvae of Stegomyia. Saddle weakly developed, extending only slightly to the sides; lateral hair short, simple; outer caudal hairs simple, long, inner hairs with 4–6 branches. Fin with 5–7 two-branched tufts on the common base and 3–4 tufts before the base. Gills only slightly shorter than the siphon, wider at the base and pointed at the end.

Distribution. Southern Europe, Africa, South and Southeast Asia. Not found in the USSR.

Biology. The larvae occur in rock pools and also in artificial water bodies near inhabited areas. They sometimes attack people in large numbers. They are apparently vectors of yellow fever. Transmission of the virus of yellow fever has been proved experimentally.

45. Aedes (Stegomyia) galloisi Yamada, 1921

It is characterized by the coloration of the thorax (mesonotum with a white longitudinal stripe and hind tarsi (last segment completely or partly dark) and by the structure of the hypopygium.

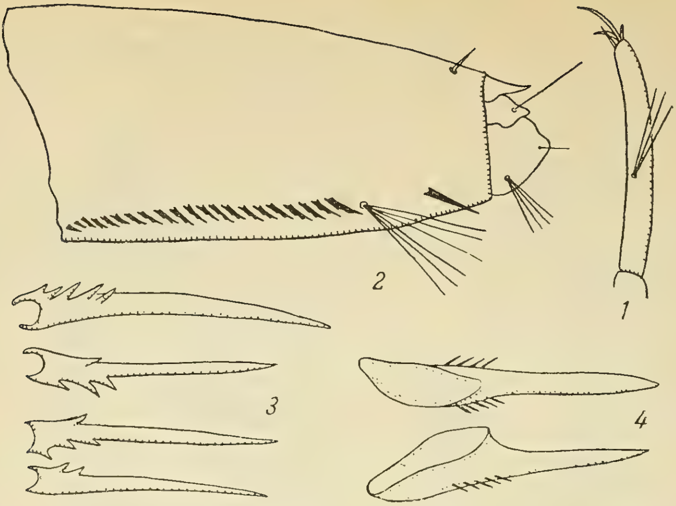

FIGURE 204. Aedes vittatus Big. Fourth-stage larva (after Barraud):
1 – antenna; 2 – siphon, lateral; 3 – denticles of pecten; 4 – scales of comb.

Mesonotum with chestnut brown scales, with a longitudinal light stripe which tapers slightly posteriorly and light lateral stripes which are curved 301 in the anterior half of the mesonotum and straight in the posterior half; scales of the median and lateral stripes with a yellowish tone in the posterior half of the mesonotum. Tarsi of all legs with narrow, white rings on the first two segments. The next segments of the fore and mid-tarsi are dark; third segment of hind tarsi white in the basal half; 4th and 5th segments white, with dark apex. Claw of fore and mid-tarsi with a denticle, claws of hind tarsi simple. Abdomen with black scales and narrow white stripes at the base of the segments, and with white spots at the sides.

In the specimens from Khabarovsk and the Maritime Territory, there are many variations in the coloration of the mid- and hind tarsi: last segment of hind tarsi completely dark, 2nd segment of mid-tarsi of female very variable, completely white, white with a dark apex, or dark with a white ring at the base (as in specimens from Japan); this segment is sometimes covered with white scales in the outside and dark scales on the inside. The coloration of the tarsi is apparently very variable. There may be two or several forms (subspecies?).

Hypopygium (Figure 205): wart-shaped process on inner surface of coxite convex, transverse, densely covered with hairs at the outer margin. Style narrower in the middle, the rod-shaped appendage situated slightly subapically. Posterior margin of tergite 9 forming a curve which is convex posteriorly, sometimes with a triangular process in the middle.

302 Fourth-stage larva (Figure 206) brown, with strongly developed, stellate hairs on the body. Their size varies according to the conditions (size of water body, density of population, food).

Frontal hairs weakly developed, median hairs situated before inner hairs, displaced to the anterior margin, outer and median hairs with 2–3

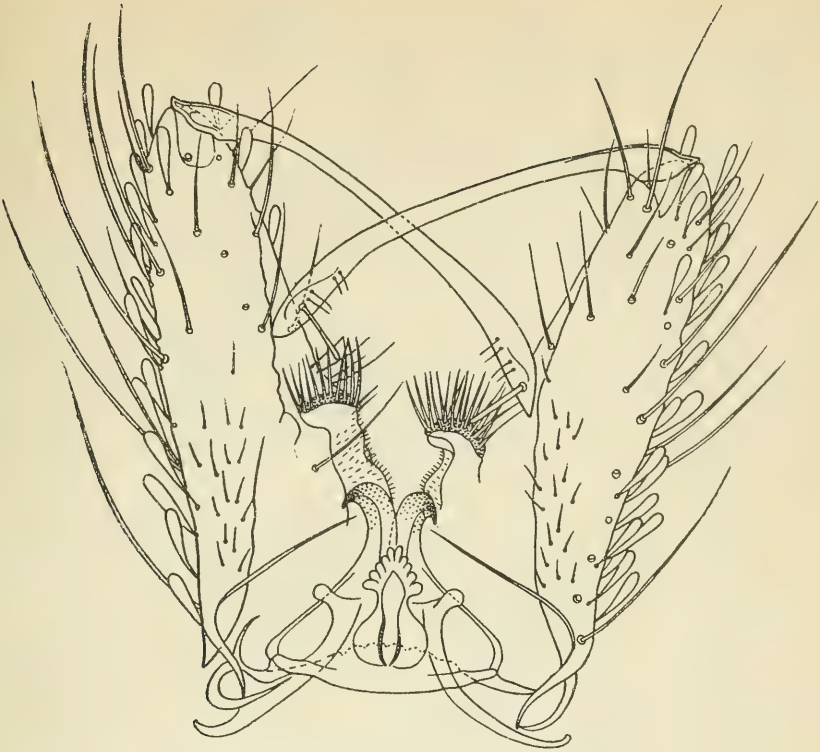

FIGURE 205. Hypopygium of Aedes galloisi Yam.

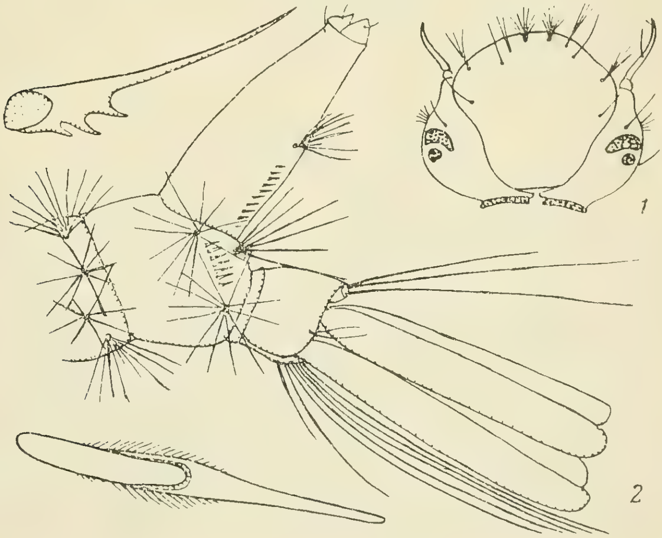

FIGURE 206. Aedes galloisi Yam. Fourth-stage larva: 1 – head, dorsal; 2 – posterior end, lateral.

branches, inner hairs simple. Postclypeal hairs situated between the median hairs, only slightly shorter than these, with 9–10 branches. Antenna short, about a third as long as the head, without spines, with a short simple hair in the middle.

Comb with 8–12 (usually 9–10) scales in one row, with a large pointed main spine and short, thin setae at the sides of the base. Siphon without auricles, dark, distinctly tapering from the middle, index 2.9–3.1. Pecten with 10–16 small, thin, spine-shaped denticles, with broad base, and with 1–3 basal accessory denticles; the distal denticle is situated before the middle of the siphon. Hair tuft situated in the middle, with 4–8 branches, not longer than the width of the siphon at the base.

Saddle extending to the lower margin of the sides of the short last segment, rarely surrounding it like a ring; lateral hair short, with 2–4 branches; outer caudal hairs simple, as long as the siphon, inner hairs with 2 branches, dorsal branch shorter. Fin weakly developed, with 6 simple (rarely 2-branched) hairs as long as the gills on the common base and 2 shorter and simple hairs before the base. Gills sausage-shaped, with rounded end, 1.2–1.6 times as long as the siphon.

Distribution. Northeast China, Korea, Japan, USSR: Khabarovsk and Maritime territory, Sakhalin, recorded also from Siberia in the Tomsk Region and the Kolyvan District in the Novosibirsk Region. The presence of this species in West Siberia is possibly due to accidental introduction by railroad.

303 Biology. The larvae occur in large numbers in water in the root and trunk holes in linden, maple, birch, Phellodendron, Siberian stone pine, together with larvae of A. alektorovi, A. nipponicus and Toxorhynchites. They are also sometimes found in rain barrels and other water storage containers which are completely or partly dark, together with larvae of A. koreicus and C. vagans. Specimens from such biotopes are twice as large as specimens from tree holes. Several generations per year from May to October. Hibernation in the egg stage. A forest species which rarely attacks man.

46. Aedes (Stegomyia) albopictus Skuse, 1895

Mesonotum with a white longitudinal stripe. The species differs from other species with a similar pattern of the mesonotum in the structure of the hypopygium and coloration of the hind tarsi.

Mesonotum mainly covered with chestnut brown scales; the white longitudinal stripe is narrower posteriorly. In the posterior half of the mesonotum there are lateral, longitudinal, white stripes, which are absent in the anterior half (in contrast to A. galloisi). At the margin of the mesonotum, before the base of the wings, is a small spot of irregular form with silvery, broad, straight scales. Tarsi of fore and mid-legs with narrow white rings at the base of the first two segments. The first four segments of the hind tarsi with wider white rings; last segment of hind tarsi completely white. Claws without denticles. Abdomen with white spots at the sides of the tergites, and sometimes with stripes at the base of the tergites which are narrower or interrupted in the middle.

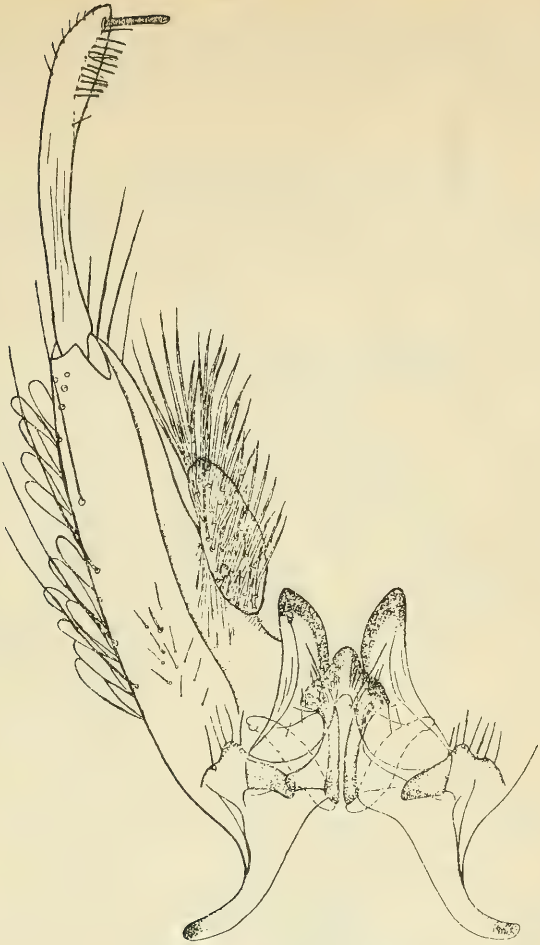

FIGURE 207. Hypopygium of Aedes albopictus Sk. (after La Casse and Yamaguti)

Hypopygium (Figure 207): lobe of coxite situated in the middle, longitudinally elongate, covered with long, simple hairs. Posterior margin of tergite 9 with a process in the middle.

Fourth-stage larva (Figure 208) medium-sized. Frontal hairs weakly developed, outer hairs with 2, rarely 1 or 3, short branches, median
304 hairs displaced anteriorly, with 1–2 branches, inner hairs situated behind the median hairs, longer, simple, with slight secondary feathering. Postclypeal hairs stronger than the median hairs, displaced anteriorly, situated close together, with 6–15 thin branches and with a short stem. Antenna short, thin, without spines, hair situated in the middle, short and simple.

Comb with 6–13 (usually 8–10) large scales in one row, with a large, pointed main spine and a row of short, thin setae at the sides of the base. Siphon without auricles, short (index 1.7–2.5), distinctly tapering from the middle. Pecten with 7–23 (usually 9–16) denticles, with broad base and several accessory denticles, the distal denticle situated in the middle of the siphon. Distal to it is a tuft with 2–4 (rarely 5–6) branches as long as the width of the siphon.

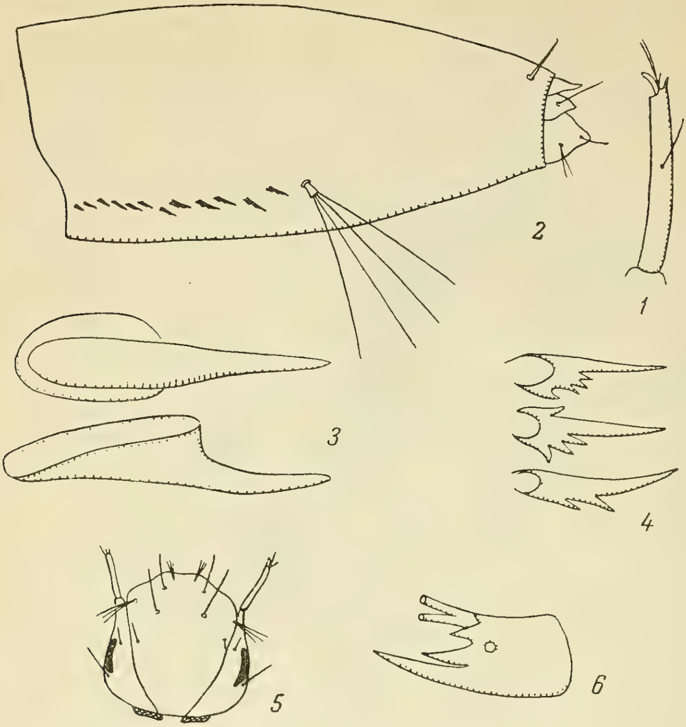

FIGURE 208. Aedes albopictus Sk. Fourth-stage larva:

1 – antenna; 2 – siphon; 3 – scales of comb; 4 – denticles of pecten; 5 – head, dorsal; 6 – base of a lateral thoracic hair (1–4 after Barraud, 5–6 after Senior-White).

Last segment short, saddle extending to ventral margin of sides; lateral hair with 2 (rarely more) branches, one of them longer than the saddle, the other half as long; outer caudal hairs simple, twice as long as the siphon or longer, inner hairs with 1–3 (usually 2–3) slightly shorter branches. Fin usually with 8 usually 2-branched tufts, the posterior branch as long as the outer caudal hair. Gills 1.5–2 times as long as the saddle, with slightly tapering, rounded end.

Distribution. It is distributed mainly in the Oriental region and Oceania, also in Africa and Australia. In the Palaearctic it occurs in North
305 China and Japan (except in Hokkaido). Not recorded in the USSR.

Biology. The larvae develop in large numbers in artificial water bodies, containers filled with water and in houses, only rarely in small, natural water bodies. Several generations per year (April–October). A. albopictus is a mass species in East Asia which occurs in large numbers in towns. Observations in Southeast Asia suggest that it feeds mainly on man. It is easily bred in the laboratory.

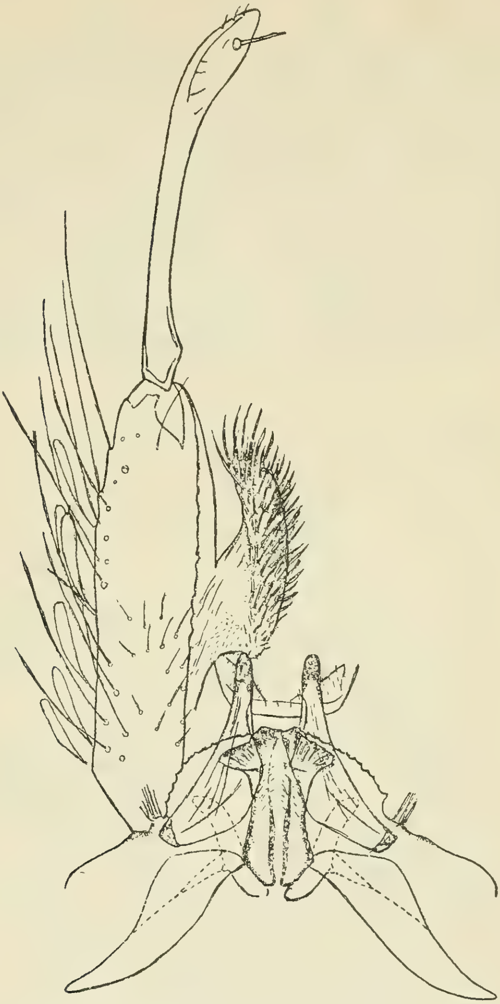

FIGURE 209. Hypopygium of Aedes flavopictus Yam. (after La Casse and Yamaguti)

Epidemiological importance. A. albopictus is an important vector of dengue in East Asia and Oceania. Some plasmodia of birds (Plasmodium lophurae, P. gallinaceum) develop in A. albopictus to the stage of sporozoites. It is not infected by filariae of man, but Dirofilaria immitis of dogs develops to the infective stage in A. albopictus.

47. Aedes (Stegomyia) flavopictus Yamada 1921

Closely related to A. albopictus but differing in details of the coloration of the mesonotum and structure of the hypopygium.

Mesonotum with chestnut brown scales, with a longitudinal white stripe which tapers posteriorly and is divided before the scutellum into two narrow stripes. There are also two indistinct, lateral longitudinal stripes in the posterior half of the mesonotum. Before the base of the wings, slightly above it is a weakly outlined spot of whitish or yellowish, narrow, slightly curved scales. Narrow, white rings at the base of the first two segments of the fore and mid-tarsi; the white rings are wider and present at the base of four segments on the hind tarsi; last segment of hind tarsi nearly completely white. Claws simple. Wings with dark scales and a small
306 white spot at the base of the costa. Abdomen with white spots at the sides of the tergites and sometimes narrow, white stripes at the base of the segments.

Hypopygium (Figure 209): lobe of coxite longitudinally elongate, extending nearly to apex of coxite; hairs of two types present on the lobe: simple hairs, slightly shorter than in A. albopictus, and flattened, lanceolate hairs. Posterior margin of tergite 9 serrated, convex, curved.

Fourth-stage larva with strongly developed stellate hairs on the body. Frontal hairs: outer hairs with 2–3 short branches, median hairs situated before the inner hairs, both pairs with 1–2 branches, the last hairs longer than the others; postclypeal hairs displaced anteriorly, situated close together, with 9–16 branches, with thin secondary feathering and with a short stem. Antenna about half as long as the head, without spines, with a simple, short hair in the middle.

Comb with 6–12 scales in a row, with a main spine and with short, thin setae at the sides of the base. Siphon short, index 2.2–2.5, tapering from the middle, without auricles. Pecten with a varying number of denticles (4–16) with a row of accessory denticles at the broad base; pecten nearly reaching middle of siphon. Hair tuft with 3–6 branches situated in the middle, about as long as the width of the siphon at the base.

Saddle of last segment extending to lower margin of sides, short, its posterior margin covered with spines; lateral hair with 2–7 branches which are longer than the saddle; outer caudal hairs simple, twice as long as the siphon, inner hairs with 2–3 slightly shorter branches. Fin with 6–8 tufts with 1–2 branches which are as long as the inner caudal hairs. Gills sausage-shaped, of varying length, as long as the saddle to as long as the siphon.

Distribution. Japan (including Hokkaido), Korea, India, Pakistan. In the USSR found only in the Kedrovaya Pad' Reserve (Southern Maritime Territory , collected by A. S. Monchadskii).

Biology. The larvae occur in water in stumps of bamboo, tree holes, and artificial water bodies in inhabited areas. The females are active bloodsuckers.

48. Aedes (Stegomyia) chemulpoensis Yamada, 1921

It is characterized by the coloration of the legs and mesonotum (absence of a white longitudinal stripe) and the structure of the hypopygium.

Mesonotum with dark brown scales and a white pattern consisting of the following parts: a) three small spots at the anterior margin, b) two large, triangular or semicircular spots at the sides of the anterior half of the mesonotum, c) small spots before the base of the wings, d) two longitudinal stripes and a small median spot (sometimes absent) in the posterior half of the mesonotum. Fore and mid-femora with a white stripe in the basal part anteriorly and several white spots in the apical half. Tibiae with a spot or ring of white scales in the first third. Tarsi with white rings at the base of the segments; last segment of hind tarsi completely white or white with dark apex. Claws without denticles. Abdominal tergites with white spots at the sides and narrow basal white stripes of uniform width.

Hypopygium (Figure 210): a sharply defined, round, rugose process densely covered with hairs in the middle of the inner surface of the coxite. 307 Style sword-shaped, without a constriction or a widening at the apex; appendage situated at the apex. Posterior margin of tergite 9 with a shallow incision.

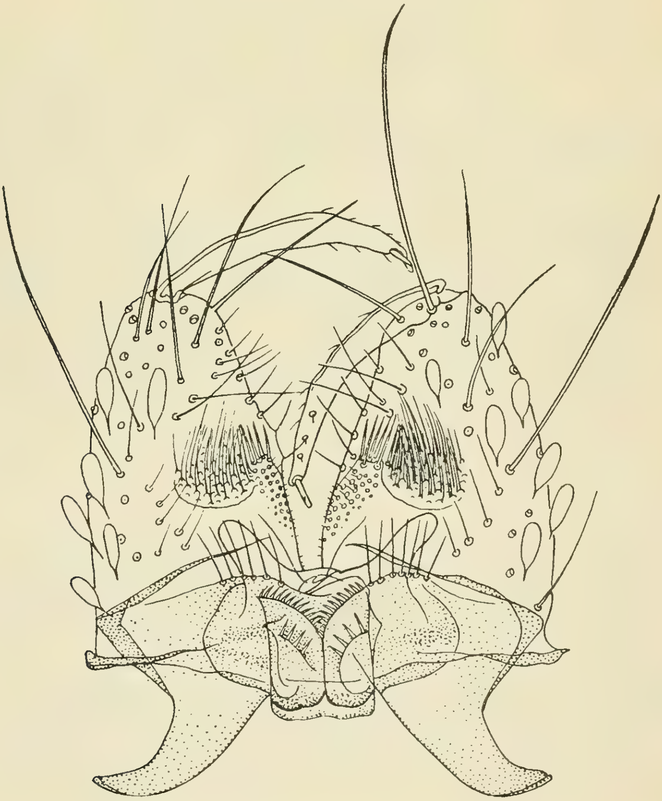

FIGURE 210. Hypopygium of Aedes chemulpoensis Yam.

Fourth-stage larva not described in detail, resembling that of A. galloisi. Frontal hairs all simple, median hairs situated before the inner hairs, strongly displaced anteriorly, median hairs nearly twice as long as the outer hairs. Postclypeal hairs situated between the median hairs, with 4–5 branches. Antenna short, smooth, with a short, simple hair beyond the middle.

Hairs on body stellate. Comb on 8th segment with 6–10 scales in a row and 2–4 accessory denticles at the sides of the base of the main spine. Siphon without auricles, index about 3.0. Pecten extending nearly to middle of siphon, with 15 denticles. Tuft with 4 branches, situated in the middle, slightly nearer to the apex.

Saddle extending to lower margin of sides of last segment; lateral hair stellate, with many branches; outer caudal hairs long, simple, inner hairs with 2–3 branches, shorter. Fin with 6 weakly branched tufts. Gills sausage-shaped, 5 times as long as the saddle, both pairs of the same length.

Distribution. Korea, North China. Not found in the USSR.

Biology. Not known. The larvae occur in holes in trunks and roots of Salix matsudana, Quercus acutissima and Sophora japonica.

308 5. Subgenus Aedes Meigen, 1818

The most distinctive character of this subgenus are the short palps of the male, which, as in the females, are about $^1/_6$ as long as the proboscis. The structure of the hypopygium is also characteristic: style bifurcate at the base, without an appendage; claspettes absent. The differences are less distinct in the females: proboscis usually as long as the fore femora, spots of scales on pleurae of thorax weakly developed, cerci distinctly projecting. There are over 70 species in the subgenus, mainly in the Oriental region.

The larvae closely resemble those of the subgenera Aedimorphus and Ochlerotatus. The only character which distinguishes the subgenus Aedes from the other subgenera is the structure of the stigmal plate and some characters of the adult mosquitoes.

49. Aedes (Aedes) cinereus Meigen, 1818

Small. Proboscis and palps dark brown. Proboscis about as long as the fore femora. Pleurae of thorax with small spots of yellowish or white scales without a silvery sheen. Tarsi dark. Wings with dark scales, without light scales. Head, mesonotum and abdomen of varying coloration in the different subspecies.

Hypopygium (Figure 211): coxite short, thick at the base, strongly tapering apically. Basal lobe of coxite well developed, densely covered with hairs; dorsal part of lobe differentiated into a dorsobasal process. Style articulated with coxite distinctly below the apex, bifurcate, the lateral branch longer and narrower than the median branch.

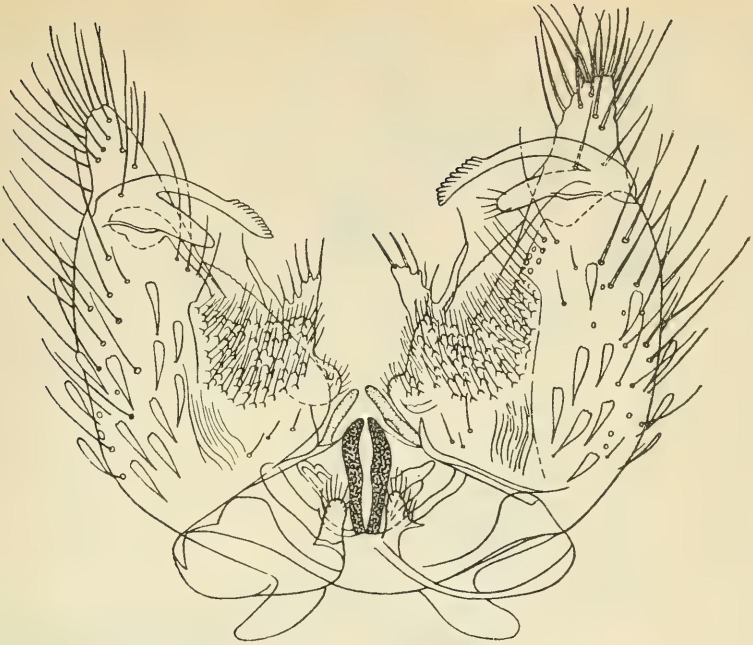

FIGURE 211. Hypopygium of Aedes cinereus rossicus D.G.M.

309 Fourth-stage larva (Figure 212) medium-sized, semitransparent, yellowish to brown or dark. Frontal hairs secondarily feathered, situated in a posteriorly concave, curved row; outer hairs with 6–14 (usually 7–8), median hairs with 3–7 (usually 5–7), inner hairs with 3–7 (usually 4–6) branches. Postclypeal hairs short, thin, with 3–7 branches. Antenna long, about 0.7 times as long as the head, with sparse spines, hair tuft with 4–7 branches situated at $^2/_5$ of the length of the antenna from the base, half as long as the antenna.

Comb on 8th segment with 10–19 (usually 14–16) scales in 1–2 irregular rows, scales with a pointed main spine and with a row of small, thin spines at the sides of the base. Siphon thin, index 3.0–4.0. Pecten $^1/_2$– $^3/_5$ as long as the siphon, with 13–21 denticles, 1–3 denticles near the base rudimentary and 1–3 distal denticles more widely spaced and larger. Hair tuft short, with 3–7 (usually 4–5) branches, situated nearer to the apex, distinctly beyond the distal denticle of the pecten. There are two pairs of short, thin, often hardly visible tufts with 2–5 branches on the anterior surface of the siphon in some larvae. At the anterior margin of the apical part of the siphon, in addition to the apical spines which are present in all larvae, there may be 4 pairs of short, thin, slightly branched hairs at the margin of the lateral surface; sometimes these hairs are fewer or they are absent.

The stigmal plate (Figure 213) differs in the structure of the posterior process of the "stirrup"; the posterior bow forms a long, chitinized stem which is wider distally; at the sides of its posterior margin are two nail-shaped processes, curved toward each other.

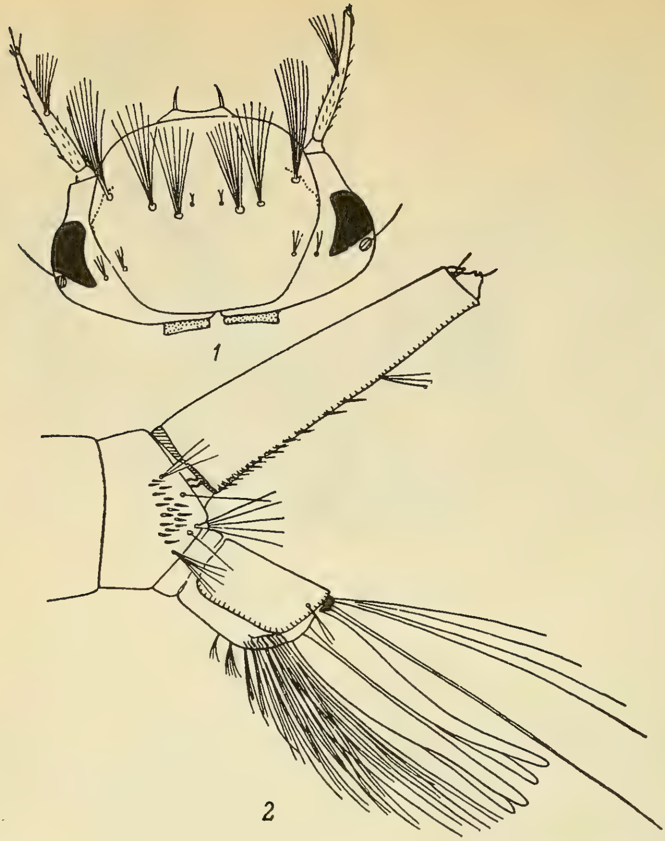

FIGURE 212. Aedes cinereus cinereus Mg. Fourth-stage larva:

1 – head, dorsal; 2 – posterior end, lateral.

310 Saddle of the last segment extending to middle of sides or beyond this; lateral hair with 2, rarely 1 or 3, branches; outer caudal hairs longer than the siphon, simple, inner hairs less than half as long, with 4–8 (usually 7) branches. Fin with 9–10 tufts on the common base and 2–4 shorter tufts before the base. Gills long, at least twice as long as the saddle, narrow, pointed, not pigmented.

Distribution. Europe, Siberia, Far East of the USSR (including Sakhalin and Kamchatka), Northeast China, Korea, Japan, Canada, U.S.A. It extends rarely to 69°N (Norway), to the Kola Peninsula and the lower reaches of the Pechora River. It reaches Transcaucasia and Middle Asia in the south.

Aedes cinereus cinereus Meigen

Head mainly with dark scales. Scales of mesonotum reddish brown, sometimes with a golden or bronze tone. Abdomen without light stripes dorsally, with a longitudinal, yellowish white stripe at the sides of the tergites.

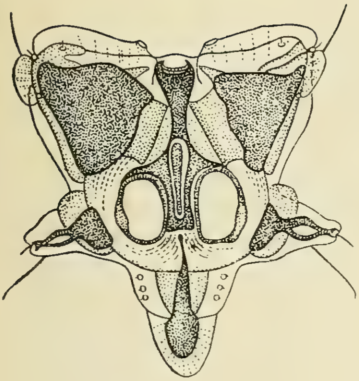

FIGURE 213. Aedes cinereus Mg. Fourth-stage larva. Stigmal plate.

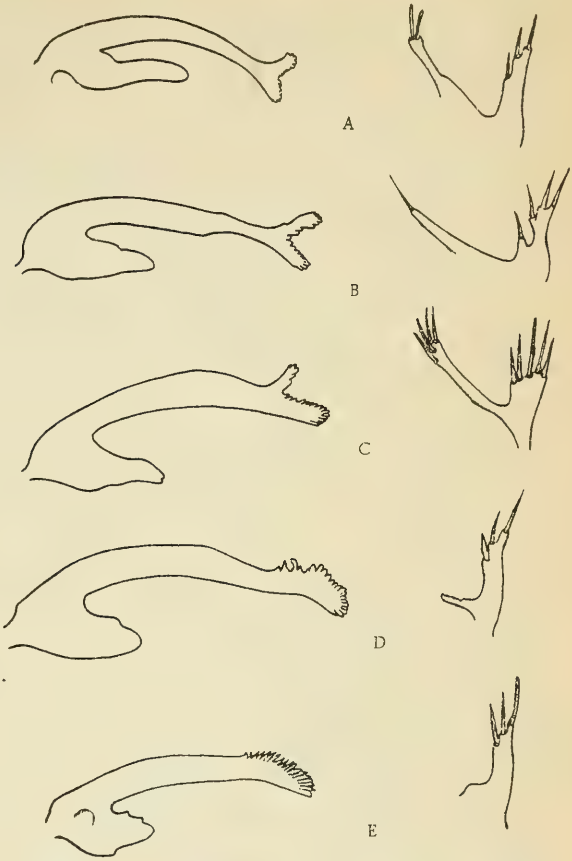

FIGURE 214. Style (left) and basal lobe of coxite of Aedes cinereus Mg. (after D.K.L'vov):

A – A. cinereus cinereus; B, C, D – transitional forms; E – A. cinereus esoensis Yam.

311 Hypopygium (Figure 214): lateral branch of style bifurcate at the apex; median branch half or a third as long as the lateral branch. Dorsobasal process of lobe with two branches, the lateral branch longer than the median.

Fourth-stage larva with the characters of the species. Typical forms do not have additional hairs on the anterior surface of the siphon or in its apical part. Transitional forms have one or two pairs of additional hairs on the anterior surface of the siphon. The gills become longer toward the eastern part of the area of distribution.

Distribution. Europe, Caucasus, Middle Asia, Kazakhstan, Siberia, Far East of the USSR, North America.

Biology. The larvae develop in permanent, deep, shaded or partly shaded water bodies in thinned forests or at their edge and in meadow swamps with shrubs or in pools with little vegetation. A. c. cinereus is a mass species in many localities and often predominates among mosquitoes attacking man. Most of its distribution is in the forest zone, but it is more characteristic for open biotopes: meadows, felled forests, shrub thickets. The mosquitoes rest in the grass and bite the legs of passers by. They are active in the morning and evening and often also during the day.

Aedes cinereus is an all-season species. The mosquitoes appear in spring later than the early spring species of Ochlerotatus and fly to the beginning of the autumn frosts. After the first generation in late spring, there is usually (but not always) a second generation after the summer rains. If the second generation is large, maximum numbers are observed in August–September (Remm, 1957).

This is one of the important vectors (mechanical transmission) in some outbreaks of tularemia.

Aedes cinereus rossicus Dolbeshkin, Gorickaja and Mitrofanova, 1930 (= A. tarnogradskii Martini, 1931)

It differs in the structure of the hypopygium and in coloration. Head mainly with whitish gray scales. Mesonotum with golden brown scales. Mesonotum with golden brown scales. An indistinct stripe of yellowish white scales at the lateral margins of the mesonotum which is more distinct in the posterior half. Abdomen with blackish brown scales dorsally, without light, transverse stripes, with a light longitudinal stripe at the sides.

Hypopygium (Figure 211): style not bifurcate at the apex; median branch of style $\frac{1}{3}-\frac{1}{2}$ as long as the lateral branch. Dorsobasal process of lobe with 2 branches.

Typical fourth-stage larvae resemble those of the nominate subspecies in all characters, but always have two pairs of additional, short hairs on the anterior surface of the siphon which may be partly or completely absent in transitional forms (Figure 215).

312 Distribution. Ukraine (Dnepropetrovsk, Kiev, Transcarpathian and Volyn regions), Caucasus (Ordzhonikidze, Teberda), Chuvashia, Urals (Perm, Orenburg) and Yakutia. Also Hungary, Czechoslovakia and Japan.

Biology. The larvae occur in small, temporary, open water bodies with vegetation. Several generations per year. A. c. rossicus apparently occurs mainly in floodplains of rivers in large numbers. The mosquitoes are vicious biters, active during the day.

Aedes cinereus esoensis Yamada, 1921

It differs in the coloration of the abdomen and structure of the hypopygium. Head and thorax as in A. c. cinereus. Abdomen with blackish brown scales dorsally, sometimes with a bronze sheen. Stripes

(311)

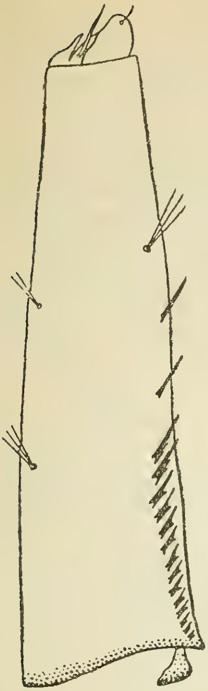

FIGURE 215. Aedes cinereus rossicus D.G.M. Fourth-stage larva. Siphon lateral.

of yellowish brown scales at the base of the tergites and spots of the same color at the sides.

Hypopygium (Figure 214): lateral branch of style not bifurcate at the apex, median branch about $^1/_3$ as long as the lateral branch. Dorsal process of lobe simple, consisting only of the median branch.

Fourth-stage larvae of this subspecies resemble those of the nominate subspecies in all characters but differ from it in the presence of 4 pairs of additional, short hairs at the apex of the siphon at the margins of the lateral surface. The hairs may not be fully developed on one side or may be absent in transitional forms. Gills longer than the siphon.

Distribution. Far East of the USSR, Kazakhstan, Northeast China, Korea, Japan.

Biology. There are apparently no differences from A. c. cinereus. In many parts of the Maritime and Khabarovsk territories, A. c. esoensis is a mass bloodsucker. It is considered as a possible vector of Japanese encephalitis (Petrishcheva, 1947).

Note on systematics. The forms we consider as subspecies of A. cinereus are often considered as different species. They differ not only in coloration but also in important structural characters of the genitalia. However, there are transitions and intermediate variations in all characters. Thus, in the forms transitional between cinereus and esoensis, the light stripes on the tergites are not present on all segments, they are sometimes very narrow or incomplete, and sometimes replaced by a small spot consisting of a few scales. The fork at the end of the lateral branch of the style, which is characteristic for A. c. cinereus, is formed by two unequal processes, one of which may be very short and indistinct. The lateral branch of the dorsobasal process is sometimes shortened or forms a small tubercle, etc.

A special study (L'vov, 1936) showed that of the two subspecies named above, only A. c. cinereus occurs in the European USSR. There are often transitional forms in Transbaikalia, which are very common in the Khabarovsk and Maritime territories where "typical" A. c. cinereus and A. c. esoensis also occur, the latter predominating. The transitions between A. c. cinereus and A. c. rossicus are similarly related. They differ less in coloration than A. c. esoensis from A. c. cinereus. The hypopygium of A. c. rossicus is intermediate in structure between that of A. c. cinereus and A. c. esoensis.

The same is observed in the larvae. All the important larval characters, including the structure of the stigmal plate, are the same in all subspecies and do not exceed the variation of the nominate subspecies. Typical larvae of A. c. cinereus do not have the additional two pairs of hairs on the

anterior surface of the siphon, but larvae occur in the same sample with one or two pairs of these hairs but in smaller numbers. The reverse is
313 the case in A. c. rossicus. Typical larvae of A. c. esoensis with four pairs of additional hairs in the apical part of the siphon are found rarely in the Far East. Most larvae have 1–2, rarely 3, pairs of hairs, frequently of different development, on both sides. One larva with completely developed hairs at the apex had two pairs of hairs on the anterior surface of the siphon. Only the typical A. c. esoensis has been described from Japan (La Casse and Yamaguti, 1955) and no transitional forms or typical A. c. cinereus have been found.

The data given speak against the species independence of A. esoensis and A. rossicus.

50. Aedes (Aedes?) nobukonis Yamada, 1932

This species is placed in the subgenus Aedes with reservation since the males are unknown. It differs from the other species of the subgenus in the presence of white spots at the sides of the abdominal segments and the absence of light stripes on the tergites.

Head mainly with brown scales dorsally. Broad grayish white scales form spots at the sides of the head. Narrow light scales are scattered in the middle of the occiput and form a border at the posterior margin of the eyes. Proboscis and palps brown. Proboscis about as long as the fore femora. Integument of mesonotum brown, scales narrow, golden-bronze. Lighter golden scales form an indistinct longitudinal stripe which is divided before the scutellum and borders a small area without scales. Scutellum with narrow, golden scales. Pleurae of thorax with spots of white scales. Legs: femora dark anteriorly, light posteriorly; tibiae and tarsi completely covered with dark scales. Claws on fore and mid-legs with a denticle, claws on hind legs simple. Wings with narrow, brown scales.

Abdomen covered with brown scales dorsally. A spot of darker scales with a faint metallic sheen on the first tergite. Basal white spots at the sides of the tergites; light stripes on tergites absent, so that the abdomen is completely dark dorsally.

Males and larvae unknown.

Distribution. Japan (Kyushu). The collection of the Zoological Institute contains a specimen with the label: Kedrovaya Pad', Maritime Territory, 26 July 1940, banks of the Kedrovka, pit under tree roots, collected by A. S. Monchadskii. This specimen shows only small differences from the original description, which states that light scales form two submedian and two lateral stripes on the head; mesonotum with a median and two submedian stripes.

Supplement to the genus Aedes

51. Aedes aureus Gutsevich, 1955

The males of this species are unknown, and its relation to the subgenera therefore remains open.

Medium-sized mosquitoes, with bright golden scales on the lateral parts of the mesonotum, a golden spot on the head, and light scales on the wings.

Head with a distinct median spot of upright, golden scales and hairs dorsally. Proboscis and palps with brown scales, and possibly some light scales in the middle of the proboscis, which is slightly longer than the fore femora. Mesonotum with a longitudinal stripe of chocolate brown scales which is wider posteriorly, lateral parts with golden scales.

314 Tarsi dark. Wings: light, cream-colored scales predominate on the subcosta and also at the base of radius, media and cubitus; veins otherwise completely or mainly covered with dark scales. Abdomen mainly with dark scales dorsally, lighter, yellowish gray scales forming spots in the middle and at the anterior margin of the tergites. Cerci very short.

Male and larvae unknown.

A character like the short proboscis (slightly longer than fore femora) suggests that the species is related to the subgenus Aedes.

K. P. Chagin found a few specimens in the Khasan area in the southern part of the Maritime Territory (Gutsevich, 1955).

8. Genus Culex Linnaeus

Medium-sized or small forms. Palps of male usually longer than or as long as the proboscis, rarely shorter (C. hayashii and many exotic species); palps of female short. Spiracular setae absent; sternopleural and upper mesepimeral setae well developed; usually one lower mesepimeral, rarely absent, still more rarely 2–3 setae; at least 4 lower mesepimeral setae only in the subgenus Lutzia. A large part of pleurae of thorax without scales; there are only some spots of a few scales. Legs: first segment of hind tarsi as long as or longer than the hind tibiae, except in the subgenus Barraudius. Claws simple in females. Wings with long radial fork. Hair absent at the base of the radius. Postalar plates with narrow scales. Cerci of female not projecting.

Hypopygium: basal lobe of coxite and claspettes absent; subapical lobe usually well developed, with more or less modified setae (plates, finger-shaped processes, etc.); 10th sternite with a group of spines or with a transverse comb of denticles at the end; phallosome usually consisting of two pairs of plates, which are often serrated at the margin and with secondary denticles.

The larvae have a large, broad head, long antennae with a well-developed hair tuft in the form of a fan with secondarily feathered branches and long subapical setae often situated some distance from the apex. Mouth parts of the filtration type of feeding, with long tufts of simple hairs on the lateral lobes of the labrum and on the mandibles. An exception are the predacious larvae of Lutzia, in which the labrum is adapted to capture prey.

Thoracic hairs usually long and branched. Chitinized plates and processes at their base moderately developed. Plates on abdominal segments absent except on the last segment, the saddle of which surrounds it like a ring. Comb at sides of 8th abdominal segment usually with numerous scales. Siphon, with rare exceptions (Lutzia, Barraudius), long or very long and thin, with well developed pecten and four or more pairs of hairs or hair tufts, situated at the lateral and posterior surface of the siphon or displaced posteriorly and forming a zigzag or straight row. Main tracheal trunks of two types: thin, with round cross section or broad, ribbon-shaped, with oblong-oval cross section. The structure of the tracheae of the first type corresponds to the stigmal plate of C. territans, the tracheae of the second type to that of C. pipiens.

315 The genus contains numerous species (over 400), most of them in the tropics of the western and eastern hemisphere. It is divided into 16 subgenera of which those occurring in the USSR are described below.

The larvae of the subgenera do not completely correspond to the subgeneric division of the adults. The species of Lutzia form a distinct group in a number of characters, combined with their predacious mode of life, but they have some characters which connect them with the larvae of Culex and Barraudius (arrangement and number of hair tufts on the siphon, details of structure of the stigmal plate). The larvae of the last two subgenera and of the subgenus Lophoceratomyia do not have characters which would make it possible to separate them. The tracheal trunks of the larvae of Neoculex are thin and with round cross section and their stigmal plate is of a special type, but the larvae of C. mimeticus and C. jacksoni, which belong to the subgenus Culex, also have such characters. The larvae of Culex form a distinct group, but this does not correspond to the adults.

Key to Species

Females

1 (4). First segment of hind tarsi distinctly shorter than hind tibiae ($^4/_5 - ^6/_7$ as long as the tibia). Small species (subgenus Barraudius Edw.).

2 (3). Abdomen with a longitudinal stripe of light scales at the sides which sometimes form more or less developed, triangular spots at the anterior margin of the tergites . . . . 3. C. (Barraudius) modestus Fic.

3 (2). Abdomen with more or less developed spots of light scales at the sides of the base . . . . .4. C. (Barraudius) pusillus Macq.

4 (1). First segment of hind tarsi slightly longer than or as long as the hind tibiae.

5 (8). Lower mesepimeral setae numerous, at least 4, usually 6–10. Large mosquitoes (subgenus Lutzia Theob.).

6 (7). All abdominal tergites with light stripes of more or less the same width at the posterior margin. Basal half of anterior surface of hind femora with numerous dark scales . . . . 2. C. (Lutzia) vorax Edw .

7 (6). Abdominal tergites 2–4 dark or with narrow, light stripes at the posterior margin; tergites 5–8 completely covered with light scales or with wide stripes of light scales at the posterior margin. Basal half of anterior surface of hind femora with white scales, without dark scales . . . . 1. C. (Lutzia) fuscanus Wied.

8 (5). Usually one lower mesepimeral seta which is rarely absent, still more rarely 2–3 setae. Usually medium-sized or smaller (subgenera Culex L. and Neoculex Dyar).

9(20). Proboscis and tarsi with white rings which are sometimes narrow.

10(13). Wings, especially on the costa, with large, light spots formed by white scales.

11(12). Apical part of cu_1 with light scales . . . . 14. C. (Culex) orientalis Edw.

316 12(11). Apical part of cu_1 with dark scales . . . . 12. C.. (Culex) mimeticus Noé.
13. C. (Culex) jacksoni Edw.

13(10). Wings without spots, sometimes with more or less numerous, scattered white scales.

14(15). Scales on wings brown, with more or less numerous white scales . . . . 9. C. (Culex) bitaeniorhynchus Giles.

15(14). Wings with uniformly brown scales.

16(19). Scales of mesonotum of 2 colors: anterior $^2/_3$ of mesonotum with light yellow or whitish gray scales, posterior third with dark brown scales.

17(18). Stripes of light scales at posterior margin of abdominal tergites. Anterior part of mesonotum with light yellow scales. Wings with narrow scales . . . . 10. C. (Culex) sinensis Theob .

18(17). Stripes of light scales at anterior margin of abdominal tergites. Anterior part of mesonotum with white scales. Wing scales broader . . . . , 11. C. (Culex) whitmorei Giles.

19(16). Mesonotum completely covered with more or less dark scales . . . scales . . . . 15. C. (Culex) tritaeniorhynchus Giles.

20 (9). Proboscis and tarsi without light rings.

21(24). Abdomen brown dorsally, without transverse stripes or lateral spots formed by light scales.

22(23). Abdomen with blackish brown scales dorsally, sometimes with indistinct stripes of white scales at posterior margin of tergites

23(22). Abdomen with reddish brown scales dorsally. (Palps of male much shorter than the proboscis.) Far East . . . . 8. C. (Neoculex) hayashii Yam.
(Palps of male longer than the proboscis.). Mediterranean . . . . 7. C. (Neoculex) martinii Med.

24(21). Abdominal tergites with more or less developed transverse stripes formed by white or yellowish scales (some specimens of C. pipiens have rarely no light stripes on the tergites).

25(28). Fore and mid-femora and tibiae dark anteriorly and with a light longitudinal stripe; rarely only the fore femora with a light stripe.

26(27). Light transverse stripes on the abdomen usually triangularly produced posteriorly. Hind femora with a dark stripe in the apical third on the ventral side . . . . 17. C. (Culex) theileri Theob.

27(26). Light transverse stripes on the abdomen of more or less the same width, not produced posteriorly. Hind femora light ventrally their entire length . . . . 18. C. (Culex) vagans Wied.

28(25). Fore and mid-femora and tibiae without anterior light stripe.

29(32). Light transverse stripes at posterior margin of abdominal tergites. Proepisterna with broad, light scales.

30(31). Palps with dark and light scales. Light stripes on abdomen relatively broad, sometimes with an anterior process. Hind tibiae with a white spot at the apex. Last segments of palps of male bare or nearly bare . . . . 6. C. **(Neoculex) hortensis** Fic.

31(30) Palps with dark scales. Light stripes on abdomen narrow, without anterior process. Hind tibiae without a white spot at the apex. Last segments of palps of male with long hairs . . . .
317 . . . . 5. C. **(Neoculex) territans** Walk.

32(29). Light transverse stripes or light lateral spots situated at anterior margin of tergites. Proepisterna with narrow, light scales.

33(34). Light transverse stripes on abdomen formed by white scales . . . 16. C. **(Culex) univittatus** Theob.

34(33). Light transverse stripes on abdomen formed by yellowish scales; the stripes are sometimes reduced or form spots at the sides of the abdomen . . . . 20. C. **(Culex) pipiens** L.
19. C. **(Culex) torrentium** Mart.

Males

1 (4). Coxite with small scales on the outer surface. Subapical lobe situated nearly in middle of coxite.

2 (3). Style relatively long and thin; phallosome short, its posterior margin not extending beyond apex of 10th sternite
3. C. **(Barraudius) modestus** Fic.

3 (2). Style short and thick; phallosome long, its posterior margin extending beyond apex of 10th sternite . . . .
4. C. **(Barraudius) pusillus** Macq.

4 (1). Coxite without scales on the outer surface. Subapical lobe situated distinctly beyond middle of coxite.

5(14). Subapical lobe of coxite without plate-shaped appendages; 10th sternite with a row of large denticles at the apex, or with several rows of short spines.

6 (9). Tenth sternite with numerous spines at the apex.

7 (8). Denticles of phallosome (sometimes indistinct) situated on body of phallosome . . . . 1. C. **(Lutzia) fuscanus** Wied.

8 (7). Denticles usually well developed, situated on a triangular process on the outer margin of the phallosome . . . .
. . . . 2. C. **(Lutzia) vorax** Edw.

9 (6). Tenth sternite with a transverse row of denticles at the apex.

10(11). Coxite with a broad, flattened, sclerotized process at the apex, extending distinctly beyond the base of the style . . . .
. . . . 6. C. **(Neoculex) hortensis** Fic.

11(10). Coxite without a process at the apex.

12(13). Style short, markedly widened beyond the middle. . . . .
. . . . 7. C. **(Neoculex) martinii** Med.

13(12). Style distinctly tapering apically . . . .
. . . . 5. C. **(Neoculex) territans** Walk.

a(b). Phallosome with numerous blunt denticles at the apex . . . . C. **territans** Walk.

b(a). Phallosome nearly smooth, without denticles at the apex . . . . C. **territans judaicus** Edw.

14(5). Subapical lobe of coxite with one or several transparent, oval or lanceolate plates, plates rarely narrow, knife-shaped. Tenth sternite with several rows of spines at the apex.

15(16). Subapical lobe of coxite with a few, knife-shaped plates . . . . 8. C. (Neoculex) **hayashii** Yam.

16(15). Subapical lobe of coxite with one plate.

318 17(18). Phallosome with a simple plate at each side which is not denticulate or divided. Plate of subapical lobe of coxite lanceolate . . . . 10. C. (Culex) **sinensis** Theob.

18(17). Phallosome with to two sclerites on each side, often divided twice or denticulate.

19(20). Phallosome with 2 simple (not divided) sclerites on each side, which are pointed at the end and sickle-shaped. Plate of subapical lobe of coxite narrow, knife-shaped . . . . 9. C. (Culex) **bitaeniorhynchus** Giles.

20(19). Phallosome with 3 sclerites on each side, if there are 2, one of them is divided or denticulate at the apex. Plate of subapical lobe of coxite broader, leaf-shaped.

21(24). Tenth sternite without basal appendage; if an appendage is present, it is rudimentary.

22(23). Second part of phallosome with 4—5 long, finger-shaped processes . . . . 11. C. (Culex) **whitmorei** Giles.

23(22). Second part of phallosome simple . . . . 20. C. (Culex) **pipiens** L.

a(b). Second part of phallosome narrow, hook-shaped . . . . C. **pipiens pipiens** L.
. . . . C. **pipiens molestus** Forsk.

b(a). Second part of phallosome broad, lobe-shaped . . . . C. **pipiens fatigans** Wied.

24(21). Tenth sternite with a distinct basal appendage which is usually very large.

25(26). Coxite with a tuft of dense hairs at the apex, directed distally, near base of style . . . . 14. C. (Culex) **orientalis** Edw.

26(25). Tuft of hairs at apex of coxite absent.

27(32). Phallosome relatively simple, with a few denticles.

28(31). Style tapering from base to apex. Plate of subapical lobe oval.

29(30). Phallosome divided at the apex into 2 plates, one of them with 2—3 laterally directed denticles . . . . . 17. C. (Culex) **theileri** Theob.

30(29). Phallosome divided into 3 plates at the apex, one of them directed distally . . . . 18. C. (Culex) **vagans** Wied.
19. C. (Culex) **torrentium** Mart.

31(28). Style widened in apical third. Plate of subapical lobe broad, asymmetrical 16. C. (Culex) **univittatus** Theob.

32(27). Phallosome complicated, consisting of many parts.

33(34). Second part of phallosome with 2—3 laterally directed denticles . . . . 12. C. (Culex) **mimeticus** Noé.
13. C. (Culex) **jacksoni** Edw.

34(33). Second part of phallosome with 4—5 denticles, the median denticles directed distally . . . . 15. C. (Culex) tritaeniorhynchus Giles.

Fourth-stage larvae

1 (2). Lateral lobes of labrum with 30—40 large, S—curved setae with a comb of short spines in the distal half. Siphon short, not longer than last abdominal segment, sharply tapering apically, pecten occupying its entire length to the tapering part (subgenus Lutzia) . . . . C. (Lutzia) vorax Edw.
C. (Lutzia) fuscanus Wied.

2 (1). Lateral lobes of labrum with normal setae. Siphon longer than last abdominal segment, not sharply tapering apically, pecten occupying at most half its length. 319

3 (4). Siphon short, usually 3 times longer than wide at the base. Hair tufts on siphon arranged in a zigzag row on the posterior surface . . . . C. (Barraudius) pusillus Macq.

4 (3). Siphon at least 4 times longer than wide at the base.

5(12). Comb of 8th abdominal segment with 4—8 large scales with a pointed main spine.

6 (7). Mentum with numerous small denticles of equal size at the margin. Hairs of lateral lobes of labrum less than the usual number of thin, angularly bent or hook-shaped, slightly branched hairs . . . . C. (Culex) bitaeniorhynchus Giles.

7 (6). Mentum with a few denticles which are larger in the middle.

8 (9). Mentum with 10—15 small denticles at the base on each side and 6—8 denticles which are larger in the middle. Subapical setae of antenna situated in the middle between end and hair tuft. Pecten with 2—4 small denticles at the base of the siphon . . . . C. (Culex) sinensis Theob.

9 (8). Mentum only with larger denticles. Pecten with 8—14 denticles occupying $^1/_4$ of length of the siphon.

10(11). Hair tufts on siphon short, as long as the width of the siphon at their position, each with 3—5 branches. Gills at most half as long as the siphon . . . . *C. (Culex) vishnui Theob.*

11(10). Hair tufts on siphon very long, more than twice as long as the width of the siphon at their position, each with 2 branches. Gills more than half as long as the siphon . . . . . C. (Culex) whitmorei Giles.

12 (5). Comb of 8th abdominal segment with at least 20 scales, without a main spine in most species, and with a row of denticles or spines of different size at the margin.

13(14). Siphon, in addition to the pecten and subapical setae, with 2—9 additional spines on the posterior side in the distal quarter . . . . C. (Culex) jacksoni Edw.

14(13). Siphon without additional spines in the distal quarter.

15(28). All hair tufts on the siphon (or except for one or two at the apex) situated on the posterior surface in a zigzag row or in pairs situated close together in the midline.

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* An asterisk indicates species included only in the key to larvae; they do not occur in the USSR.

16(21). Main tracheal trunks narrow, less than half as wide as the siphon, with round cross section. Stigmal plate of the "C. territans" type.

17(18). Inner and median frontal hairs short, at least half as long as the outer hairs. Denticles of pecten forming long, thin spines with a row of pointed, thin accessory denticles on the entire posterior margin. Fat body dark, so that the larvae appear transversely striated . . . . C. (Neoculex) hayashii Yam.

18(17). Inner and median frontal hairs as long as or longer than the outer hairs. Fat body not dark, larvae not appearing transversely striated.

320 19(20). The basal 2—3 hair tufts on the siphon situated between the more widely spaced distal denticles of the pecten, at least 3 times longer than the width of the siphon, the following tufts become shorter toward the apex . . . . C. (Neoculex) hortensis Fic.

20(19). Basal hair tufts on siphon situated distal to the last denticle of the pecten; hair tufts usually twice as long as the width of the siphon . . . . C. (Culex) mimeticus Noé.

21(16). Main tracheal trunks ribbon-shaped, broad, more than half as wide as the siphon, with oval cross section. Stigmal plate of the "C. pipiens" type.

22(25). The first 3 basal hair tufts on the siphon situated between the more widely spaced distal denticles of the pecten.

23(24). In addition to the hair tufts forming a zigzag row on the posterior surface of the siphon, there are 2 pairs of shorter tufts in the apical quarter of the siphon, one pair farther from the apex and situated at the lateral surface, the other at the border of the lateral and posterior surface . . . . *C. (Culex) laticinctus Edw.

24(23). All hair tufts on the siphon situated on the posterior surface . . . . C. (Barraudius) modestus Fic.

25(22). Basal hair tufts on siphon situated distal to the last denticle of the pecten.

26(27). Subapical setae of antenna situated at the apex of the narrow terminal part of the antenna. Five pairs of hair tufts on the siphon, the penultimate tuft from the apex situated on the lateral surface . . . . C. (Culex) theileri Theob.

27(26). Subapical setae on antenna situated at $^1/_4-^1/_3$ of the length of the narrow apical part of the antenna before the apex. Six to 8 pairs of hair tufts on the siphon situated either in pairs or in a zigzag row. Two pairs of tufts near the apex situated on the lateral surface of the siphon . . . . C. (Culex) orientalis Edw.

28(15). Hair tufts on siphon situated in pairs at the margins of the posterior surface, some tufts may be situated on the lateral surface.

29(32). Siphon widest in the middle, more strongly tapering apically than toward the base.

30(31). Four pairs of hair tufts situated at sides of posterior surface of siphon in a line, their length less than the width of the siphon at their position. Width of siphon at the apex half its width at the base . . . . *C. (Culex) gelidus Theob.

31(30). The penultimate pair from the apex of the 4 pairs of hair tufts on the siphon situated on the lateral surface; hair tufts at least as long as the width of the siphon at their position. Width of siphon at the apex more than half its width at the base . . . . C. (Culex) **pipiens fatigans** Wied.

32(29). Siphon widest at the base.

33(36). Main tracheal trunks narrow, less than half as wide as the siphon, with round cross section. Stigmal plate of the "C. territans" type.

34(35). Siphon (index about 7) distinctly wider at the apex. Denticles of pecten with 1—2 accessory denticles at the posterior margin . . . . C. (Neoculex) **territans** Walk.

35(34). Siphon (index 7.5—11) not wider at the apex or only slightly widened. Denticles of pecten with 3—5 long accessory denticles at the posterior margin . . . . C. (Neoculex) **martinii** Med.

321 36(33). Main tracheal trunks ribbon-shaped, broad, more than half as wide as the siphon, with oval cross section. Stigmal plate of the "C. pipiens" type.

37(38). Hair tufts on siphon very short, less than half as long as the width of the siphon at their position. . . . . . *C. (Culex) **laurenti** Newst.

38(37). Hair tufts on siphon more than half as long as its width at their position, or longer.

39(42). All hair tufts on siphon of the same length.

40(41). Six to 7 pairs of tufts on the siphon. Inner caudal hairs with 3 branches. Subapical setae on antenna situated at $\frac{1}{4}$—$\frac{1}{3}$ of the length of the narrow terminal part from the apex . . . . C. (Culex) **tritaeniorhynchus** Giles.

41(40). Four to 5 pairs of hair tufts on the siphon. Inner caudal hairs with 2 branches. Subapical setae on antenna situated near apex of narrow terminal part of antenna . . . . C. (Culex) **univittatus** Theob.

42(39). At least the first two pairs of hair tufts from the base of the siphon longer than the others and longer than the width of the siphon at their position.

43(44). A pair of hair tufts near the apex is the most lateral . . . . C. (Culex) **torrentium** Mart.

44(43). The second pair of hair tufts from the apex of the siphon is the most lateral.

45(48). Four pairs of hair tufts on the siphon. The basal pair of hair tufts of the siphon situated distinctly distal to the distal denticle of the pecten. Lateral hair on last segment ususally simple.

46(47). Siphon longer (index more than 4.5). Gills distinctly longer than the saddle, both pairs of the same length. Ends of posterior tufts of fin at the same level as ends of gills . . . . C. (Culex) **pipiens pipiens** L.

47(46). Siphon shorter (index at most 4.5). Gills not longer than the saddle, lower pair slightly shorter than the upper. Ends of posterior tufts of fin distinctly extending beyond ends of gills . . . . C. (Culex) **pipiens molestus** Forsk.

48(45). Five pairs of tufts on the siphon. The basal pair situated at the same level or between the 1st and 2nd distal denticles of the pecten. Lateral hair on last segment usually 2-branched . . . . C. (Culex) vagans Wied.

1. Subgenus Lutzia Theobald

The species of Lutzia differ from the species of the other subgenera of Culex in the presence of 4 or more lower mesepimeral setae.

The larvae have a small, rounded head with mouth parts adapted for a predacious mode of life. The lateral lobes of the labrum catch the food; their hairs are modified to about 40 of large, curved setae on a strong, broad base. The teeth on the maxillae are large and long. Frontal hairs long, usually simple. Siphon short, with a median row of hair tufts along nearly the entire posterior surface; pecten extending distinctly beyond middle of siphon. Last abdominal segment very long, often longer than the siphon. The ring of the saddle of this segment is much wider on the dorsal side than on the ventral side.

A small subgenus (7 species) in the tropics of the New World (2 species) and the Old World (4 species in the Oriental region, one in the Ethiopian
322 region); two Oriental species occur in the Palaearctic.

The larvae occur in small natural and artificial water bodies, often near inhabited areas, and together with larvae of other species of mosquitoes (A. koreicus, C. vagans, and others). They occur from June to autumn. The females are normally not bloodsuckers.

1. Culex (Lutzia) fuscanus Wiedemann, 1820

Large mosquitoes, with a distinct coloration of the abdomen. Head with narrow, whitish scales and numerous upright, dark scales. Proboscis with dark scales at the base and apex, with light scales in the middle which sometimes predominate. Palps of female with dark and light scales, palps of male with indistinct light rings and light apex. Mesonotum with golden brown, narrow scales and with light scales which form indistinct spots or stripes. Legs: anterior surface of fore and mid-femora with dark scales and numerous light scales; anterior surface of hind femora with white scales in the basal half, except at the dorsal margin. The light scales in the apical half of the dorsal surface of the hind femora form a line to the apex. Tarsi without light rings. Wings with brown scales. Abdomen: tergites 5–8 with yellow scales or the scales form broad stripes at the posterior margin of the tergites; tergites 2–4 dark or with narrow stripes of light
323 scales at the posterior margin. The abdomen thus appears distinctly 2-colored dorsally: the anterior half dark, the posterior half light. This contrast is less distinct in the males.

Hypopygium (Figure 216): coxite moderately thick; subapical lobe of coxite with 3 thick spines and several hairs; style tapering apically.

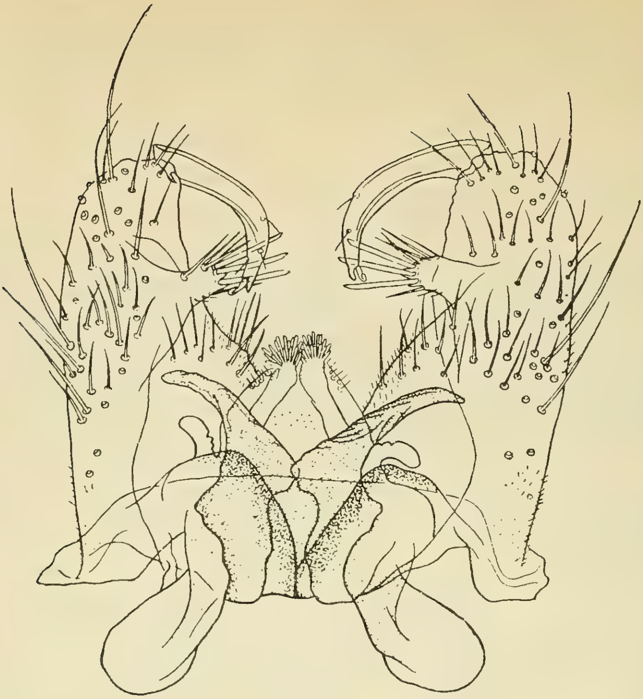

FIGURE 216. Hypopygium of Culex fuscanus Wied.

Phallosome markedly sclerotized, without denticles on its narrow, curved part or with a few small denticles. Plates of 10th sternite with numerous spines at the apex; basal process of 10th sternite well developed but weakly sclerotized. Lobes of 9th tergite slightly convex, with a row of long spines.

Fourth-stage larva* (Figures 217 and 218) large, with yellowish brown body and yellowish red or brownish red head and lighter siphon.

Head slightly oblong. Labrum modified for catching prey, lateral lobes consisting of about 40 strong, slightly S-curved setae with a row of thin spines at the end. Teeth of mandibles large and long. Antennae short, with a short hair near the base and large, pointed setae at the end. Frontal hairs long, simple or 2-branched. Siphon short, with distinctly tapering apex because of the curved posterior surface, on which are situated 14–15 long hair tufts with 2–3 secondarily feathered branches, extending its entire length. Beyond the middle of the siphon is a pair of thin, shorter hairs on the lateral surface. Pecten with 8–11 denticles, occupying the siphon to the apical tapering. Comb with 35 or more scales, varying from elongate scales with a distinct main spine to short scales with a row of spines at the margin. Last segment distinctly longer than the siphon.

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[*] The species of Lutzia are not distinguishable with certainty by the larvae. This description may refer also to larvae of Culex (Lutzia) vorax.

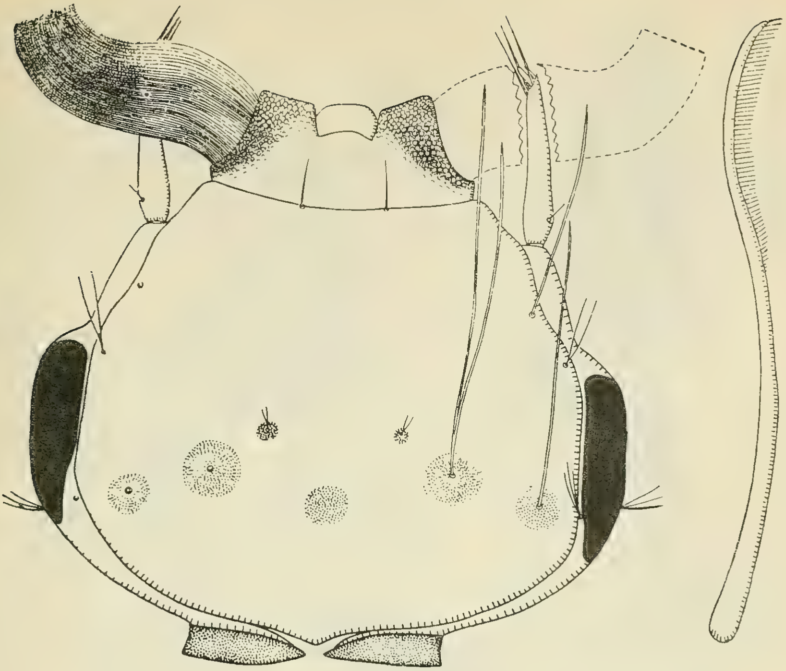

FIGURE 217. Culex fuscanus Wied. Fourth-stage larva. Head, dorsal, and seta of labrum.

324 Saddle surrounding the segment like a ring and more than twice as long on the dorsal side than on the ventral side; its posterior margin thus sharply sloping. Saddle covered with small spines. Caudal hairs long, simple. Gills short.

Distribution. USSR: southern part of the Maritime Territory. Korea, Japan, China, Southeast and South Asia.

Biology. The larvae are found in small, stagnant water bodies, natural and artificial, near inhabited areas. They feed on larvae of other Culicidae.

2. Culex (Lutzia) vorax Edwards, 1921

Closely related to C. fuscanus, differing as follows: femora and tibiae mainly with dark scales and with light scales which form spots which regularly alternate with the dark parts. Anterior surface of hind femora with numerous dark scales in the basal half of anterior surface, without a longitudinal line formed by white scales. Abdominal tergites 2–8 with narrow stripes of light scales at the posterior margin. Apex of palps of male dark. Denticles of phallosome situated on a distinct, triangular, lateral process (Figure 219).

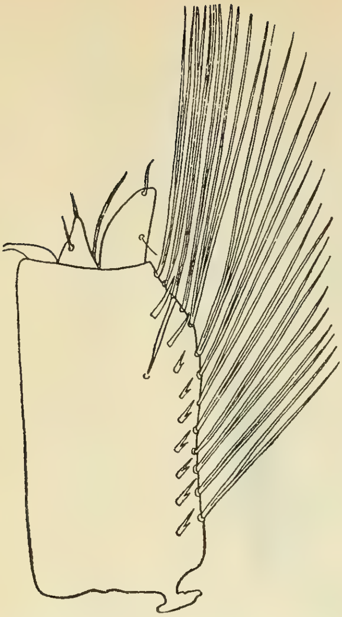

FIGURE 218. Culex fuscanus Wied. Fourth-stage larva. Siphon, lateral.

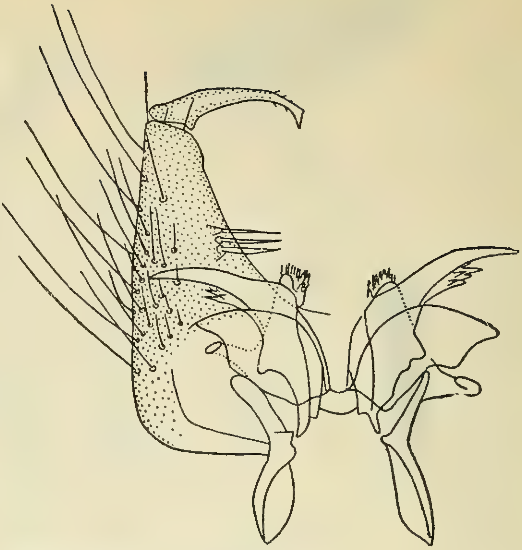

FIGURE 219. Hypopygium of Culex vorax Edw. (after Barraud)

Larvae, see C. (L.) fuscanus.

Distribution: USSR: southern part of the Maritime Territory. Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Southeast and South Asia.

325 Biology. The larvae occur in Japan in various water bodies, wooden or metal rain barrels, etc., rarely in natural water bodies. They tolerate a high degree of pollution. They often occur together with larvae of Culex pipiens and C. tritaeniorhynchus, which they kill in large numbers. It rarely bites man.

2. Subgenus Barraudius Edwards

First segment of hind tarsi distinctly shorter than the tibia (about $^4/_5$ as long as the tibia); palps of male longer than the proboscis, without long hairs; head with narrow scales at the margin of the eyes. Coxite with scales on the outside; subapical lobe situated slightly beyond the middle, without plate-shaped appendages.

Larvae, see p. 339.

The subgenus contains only two species.

3. Culex (Barraudius) modestus Ficalbi, 1889

Small mosquitoes. Head with yellowish brown scales. Proboscis and palps brown. Palps of male very thin as they do not bear long hairs. Mesonotum with brown scales, scutellum with whitish scales, femora and tibiae with brown scales anteriorly and white scales posteriorly. First segment of hind tarsi distinctly shorter than hind tibia. Wings with brown scales; abdomen with brown scales, with a longitudinal stripe of yellowish white scales laterally.

(326)

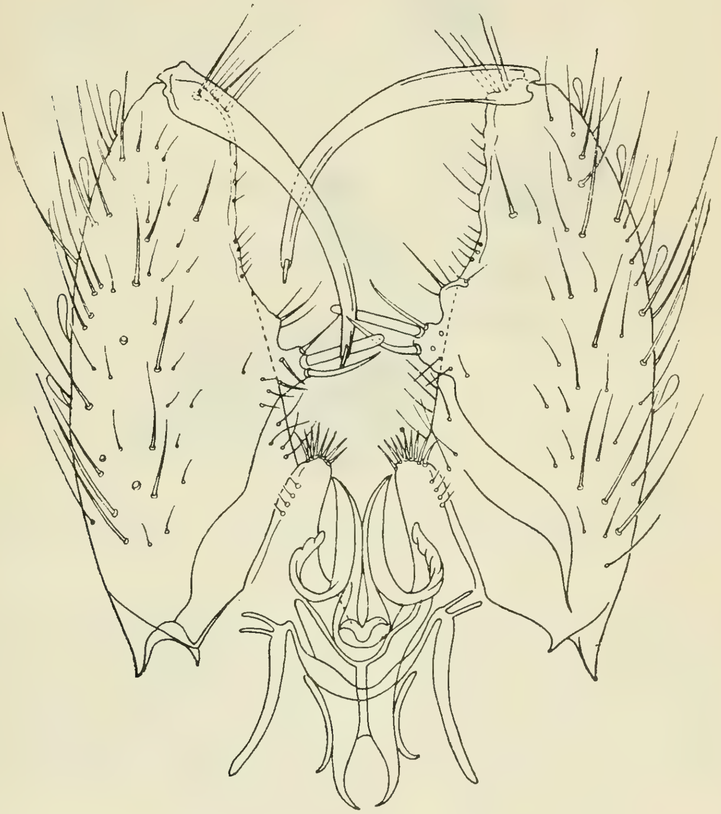

FIGURE 220. Hypopygium of Culex modestus Fic.

Hypopygium (Figure 220): coxite with more or less dense scales on the outside; subapical lobe situated slightly beyond middle of coxite, without plate-shaped appendage, lobe with 2–3 thick, blunt spines and a few hairs; style curved in apical half, thin and long, more than half as long as the coxite, rarely as long as this; phallosome forming a simple, nearly straight plate on each side which does not project beyond the apex of the 10th sternite which is covered with spines.

(326)

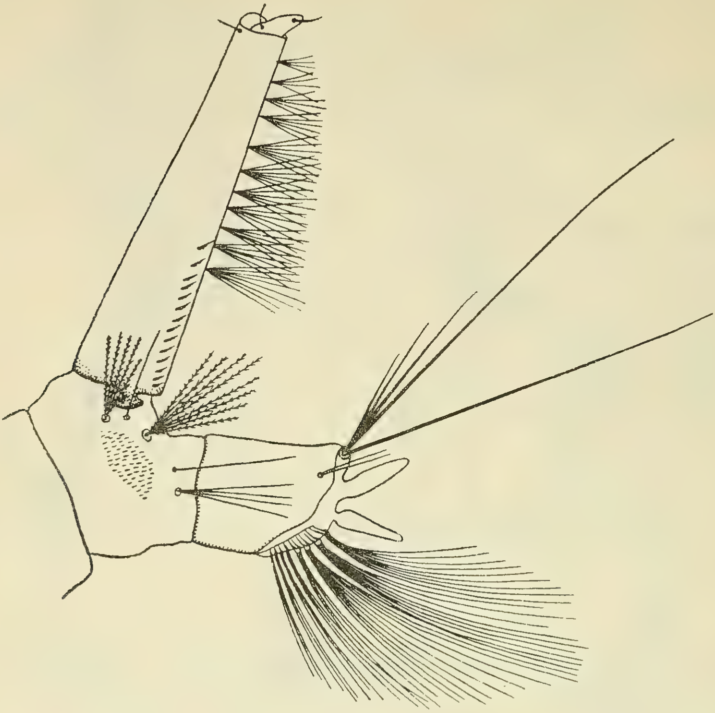

FIGURE 221. Culex modestus Fic. Fourth-stage larva. Posterior end, lateral.

Fourth-stage larva (Figure 221) weakly pigmented, nearly transparent, with light head and siphon. Head nearly 1.5 times wider than long. Mouth parts of the filtration type. Antennae moderately spinose, light, with darker base, tapering from the hair tuft (at about $^3/_5$ of the length of the antenna from the base), with 15–25 secondarily feathered branches, half as long as the antenna. Frontal hairs secondarily feathered, outer hairs with 7–8, median hairs with 3–4 (rarely 2), inner hairs with 3–5 (rarely 2) branches.

Comb of 8th abdominal segment with 50 and more adjacent, small, oblong scales with a row of spines at the apex and part of the sides. Siphon straight, tapering apically, 3.8–5 times longer than its width at the base. Pecten occupying about $^2/_5$ of the length of the siphon, with 12–13 relatively widely spaced, thin denticles with 3–5 accessory spines at the posterior margin. About 10 hair tufts in the middle of the posterior surface in a zigzag row; they begin at the 2–3 distal denticles of the pecten and extend nearly to the apex. The 2–4 apical tufts may be shorter than
327 the others and less branched. The other tufts are as long as or longer than the width of the siphon at their position, with 5–7 branches. Main tracheal

trunks broad, ribbonlike. Stigmal plate as in C. pipiens. Last segment surrounded by the saddle like a ring, slightly longer than wide. Lateral hair with 2–3 short branches. Outer caudal hairs long, simple, inner hairs shorter than the outer, with 3–4 branches, the lower branch longer. Fin with 11–13 tufts with 5–7 branches. Gills distinctly shorter than the saddle, both pairs of the same length.

Distribution. USSR: European part to the Moscow and Sverdlovsk regions in the north, Caucasus, Transcaucasia, Middle Asia, Kazakhstan, southern Siberia to the Maritime Territory. Southern Europe, Southwest Asia, Northern India.

Biology. The larvae occur from the end of spring to late autumn in fresh or slightly saline water bodies, in well illuminated marches, with rich vegetation, together with larvae of A. maculipennis, A. m. sacharovi, A. hyrcanus and rarely of A. pulcherrimus. The mosquitoes are found on meadows and other open habitats.

Natural infection of C. modestus with tularemia has been found.

4. Culex (Barraudius) pusillus Macquart, 1850

Small mosquitoes, differing, like C. modestus from other Palaearctic species of Culex in the shorter first segment of the hind tarsi, which are $^4/_5$ as long as the tibia. It differs from C. modestus in its darker coloration and white lateral spots at the base of the abdominal tergites.

Hypopygium (Figure 222): style straight or slightly curved, relatively short (in distinction to C. modestus), less than half as long or half as long as the coxite; the markedly convex lobe of the coxite bears two thick, spines of different size, with thin, curved end and numerous setae and hairs; phallosome on each side with a separate narrow, long plate which is curved at the end; apex of phallosome usually projecting beyond apex of 10th sternite, densely covered with spines, nearly reaching to the subapical lobe.

Fourth-stage larva (Figure 223) nearly transparent, yellowish or pale yellowish green, with slightly pigmented head and siphon. Head transverse-oval, 1.4 times wider than long. Antennae weakly spinose, long, 0.8–0.9 times as long as the head, pale, except at the base and with tapering terminal part. Hair tuft with 15–25 secondarily feathered branches, more than half as long as the antenna; subapical setae situated near the apex. Frontal hairs long, outer hairs with 7, median and inner hairs with 2–3 branches. Comb of 8th abdominal segment with 50 or more small, adjacent scales with a row of spines at the margin. Siphon short, 2.6–3.2 longer than its width at the base. Pecten about half as long as the siphon, with 11–13 denticles. About 10 hair tufts are situated in a zigzag or straight line in the middle of the posterior surface of the siphon; about 3 basal tufts are situated between the distal denticles of the pecten. Tufts with 8–10 branches at least as long as the width of the siphon. Main tracheal trunks broad, ribbonlike. Stigmal plate as in C. pipiens. Last segment slightly shorter
328 than the siphon. Lateral hair short, with 1–2 branches. Outer caudal hairs more than 1.5 times as long as the siphon, inner hairs shorter, with one, rarely 2, shorter branches. Fin with 12 well developed tufts. Gills about half as long as the saddle, upper pair slightly longer than the lower.

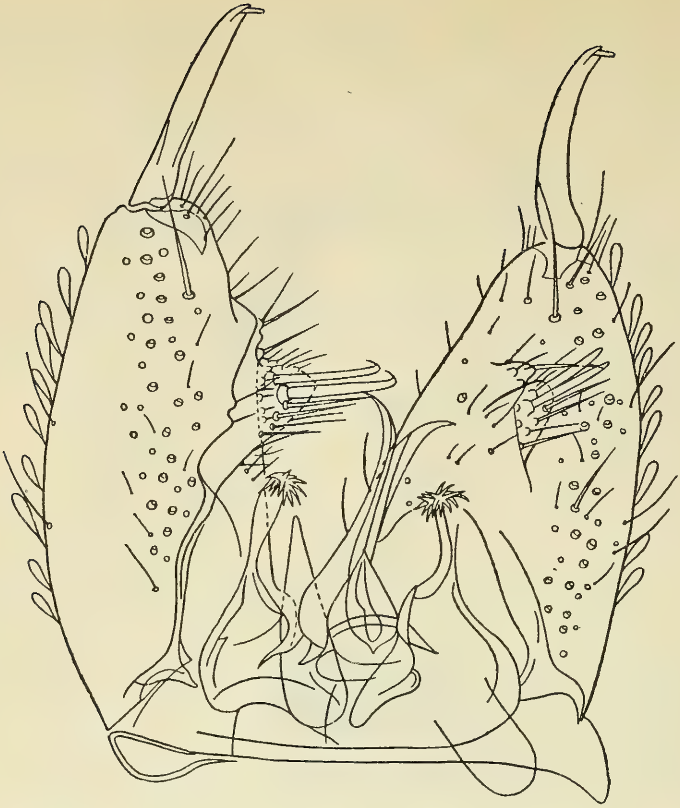

FIGURE 222. Hypopygium of Culex pusillus Macq.

Distribution. Mediterranean, mainly the eastern part. USSR: Middle Asia (Turkmenia, Uzbekistan, Tadzhikistan). North Africa (Algeria, Egypt), West Asia (Anatolia, Iran, Iraq).

Biology. The larvae occur in stagnant water bodies and swamps with a high content of salt (to 3%), often together with larvae of A. caspius, A. pulcherrimus and others. Breeding places mainly near the coast, salt lakes and oases. Not a common species.

3. Subgenus Neoculex Dyar

Coxite without scales, subapical lobe with more or less large, spine-shaped appendages, usually without a leaf-shaped plate. Tenth sternite of most species without a basal process, with a group of spines or a row of blunt, plate-shaped processes at the apex; phallosome simple, formed by one pair of plates.

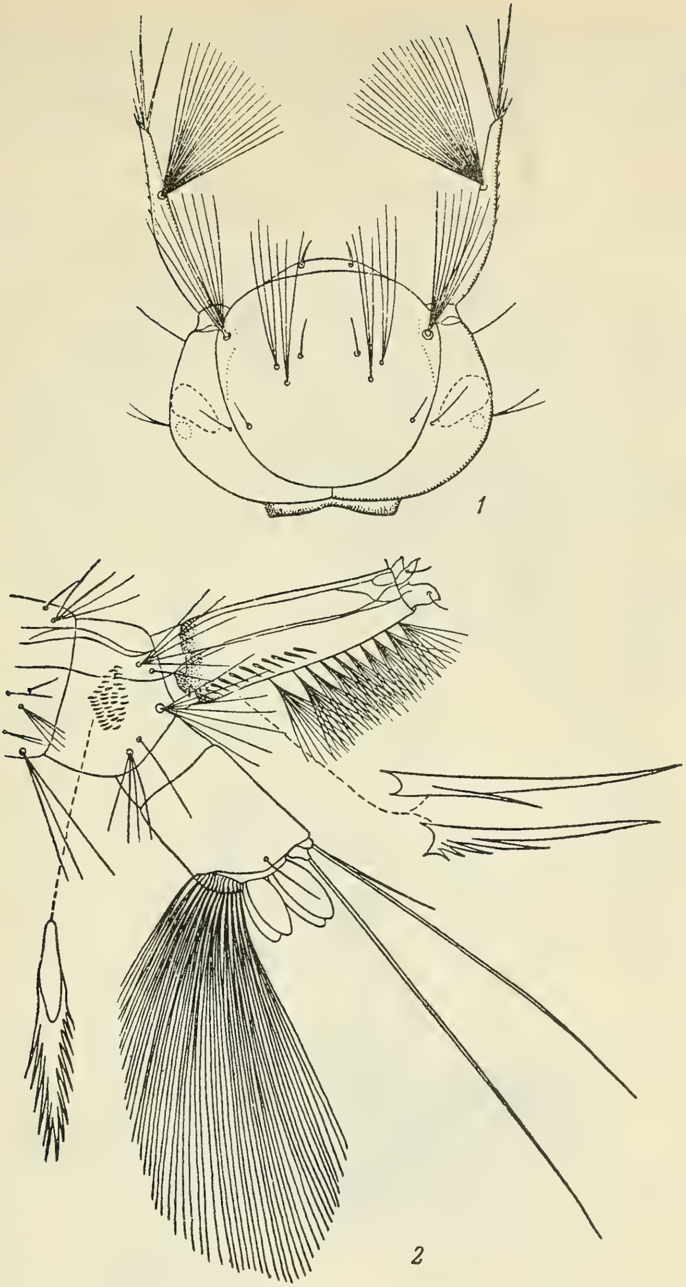

FIGURE 223. Culex pusillus Macq. Fourth-stage larva (after Edwards):
1 — head, dorsal; 2 — posterior end, lateral.

330 The larvae have a long, thin siphon which is sometimes slightly wider apically, thin main tracheal trunks with round cross section, and stigmal plate of the C. (N.) territans type. The larvae of C. (Culex) mimeticus and C. (Culex) jacksoni closely resemble those of Neoculex.

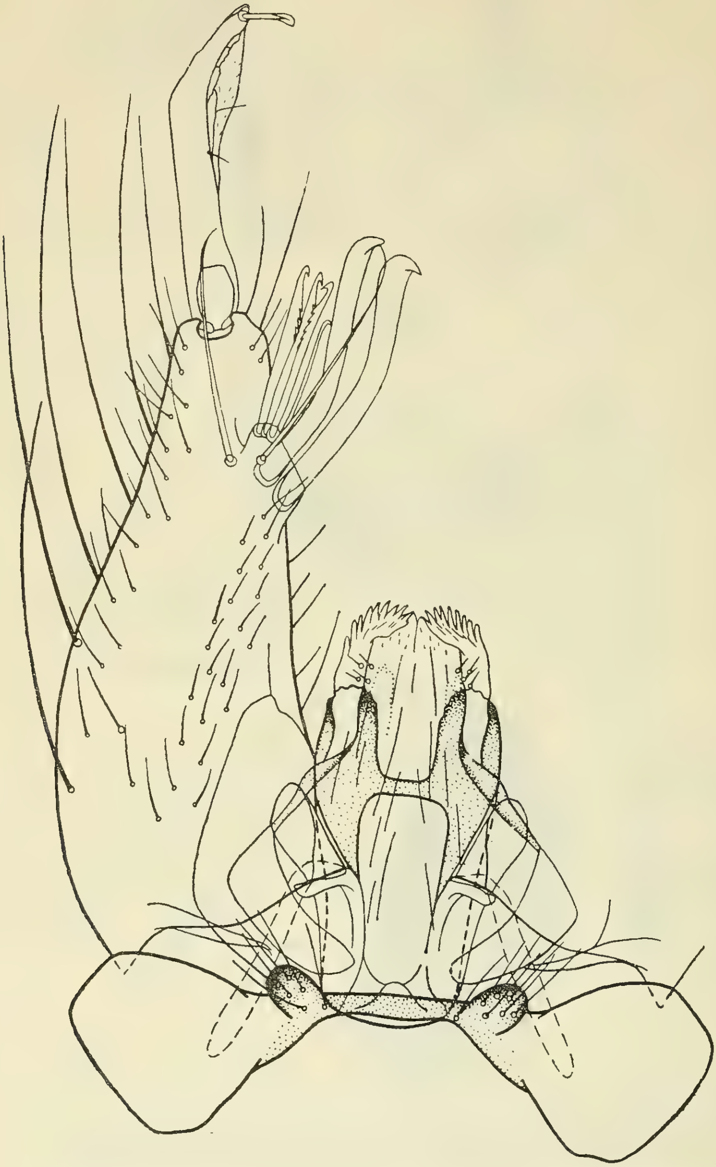

FIGURE 224. Hypopygium of Culex territans Walk. (after Carpenter and La

The subgenus contains about 60 species, 30 species in tropical Africa, 9 in the Oriental region, 10 in Australia, 5 in Central America and 8 in the Palaearctic region (one of them also in the Nearctic region). C. terri-
331 tans has a holarctic distribution, 5 species occur in the Mediterranean in the broad sense (2 species reach Middle Asia) and 2 occur in the Far East.

5. Culex (Neoculex) territans Walker, 1856 (apicalis auct., nec Adams)

Described from the United States of America. The related species C. apicalis Adams, 1903 was also described from the U.S.A. The European species of the subgenus Neoculex was first identified as C. apicalis and appeared under this name in many publications (Edwards, 1921, 1926; Martini, 1931; Monchadskii, 1936, 1951; Shtakel'berg, 1937, and others). However, later study showed that the Palaearctic species is identical with C. territans and not with C. apicalis, which is distributed in the southwestern part of the United States and in Mexico, but does not occur in the Palaearctic (Mattingly, 1953, 1955; Kramář, 1957). Thus all Russian records and mentions of C. apicalis refer to C. territans.

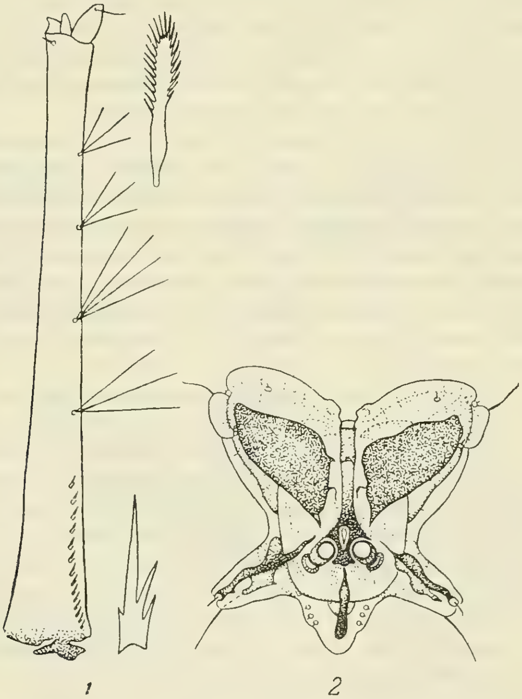

FIGURE 225. Culex territans Walk. Fourth-stage larva:
1 – siphon, lateral; 2 – stigmal plate.

C. rubensis Sasa and Takahashi, from Japan is probably a Far Eastern subspecies of C. territans. The two forms are indistinguishable in adults and larvae (La Casse and Yamaguti, 1955) and C. rubensis is probably a synonym of C. territans.

Culex territans differs from related forms, particularly from C. hortensis, in its usually darker coloration, the long hairs on the palps of the male and structure of the hypopygium.

Head with white and yellowish scales. Proboscis and palps dark brown, with dark brown scales, without light scales. Palps of male with long hairs on the last two segments. Mesonotum with brown scales; anterior and lateral margins of mesonotum and scutellum with whitish gray scales. Pleurae of thorax gray, with spots of white scales. Legs dark brown, femora and tibiae with dark brown scales anteriorly, tarsi entirely with dark brown scales; femora and tibia with whitish scales posteriorly; apex of hind tibiae without a white spot. Veins of wings with dark brown scales. Abdomen with blackish brown scales dorsally, with narrow, white transverse stripes of more or less the same width at the posterior margin of the tergites. Abdomen usually greenish ventrally, with brown and white scales, usually forming broad transverse stripes.

Hypopygium (Figure 224): subapical lobe of coxite with 2 thick, transparent spines, curved at the end and several setae, straight or slightly
332 curved or denticulate. Phallosome with 2 simple plates connected by a transverse bridge at the base and before the apex (there is no transverse bridge in the apical part of the phallosome in C. apicalis which is the main difference from C. territans). The development of this bridge varies markedly according to material from different parts of the USSR. It may be broad or narrow, sometimes very narrow.

Fourth-stage larva (Figure 225) at first transparent, later yellowish green or bluish green. Head and siphon also become brown.

Head 1.6 times wider than long. Mouth parts of the filtration type. Antennae nearly as long as the head, with a fan-shaped tuft of 25–32 secondarily feathered branches, $^3/_4$ as long as the antenna; subapical setae situated at the apex. Frontal hairs long, outer hairs secondarily feathered, with 6–8 median branches, hairs longer, simple, inner hairs with 2 branches.

Comb of 8th abdominal segment with 50 or more oblong, small scales with a row of small spines at the margin. Siphon thin, 7 times longer than wide at the base; slightly but distinctly widening at the apex. Pecten with 13–16 denticles occupying about $^1/_4 - ^1/_3$ of the length of the siphon from the base. Four to 6 pairs of hair tufts which are longer than the width of the siphon, with 2–4 branches situated at the border between the sides and the posterior surface of the siphon. Basal pairs situated more closely together than the apical pairs. Main tracheal trunks thin, with round cross section. Stigmal plate (Figure 225) with strongly developed posterior valves, a long, thin, posterior process of the "stirrup" and small, deeply invaginated, rounded spiracles. Last abdominal segment long, with a ring-shaped saddle. Caudal hairs: outer hairs longer than the siphon, simple, inner hairs with 4 shorter branches. Fin with 13–14 tufts. Gills nearly as long as the saddle, lower pair shorter than the upper.

Note on systematics. The species is divided into two subspecies — C. t. territans and C. t. judaicus, which is sometimes considered as a different species (Mattingly, 1953), but more proof is necessary to confirm its status.

Distribution. USSR: European part from the Leningrad and Sverdlovsk regions in the north to the Ukraine, Crimea, Ciscaucasia and Lower Volga area in the south, Caucasus and Transcaucasia, Middle Asia, Kazakhstan, Siberia, Far East. Greater part of Europe outside the USSR, Japan, North Africa and North America.

Biology. The larvae occur from June to the end of September in temperate latitudes, mainly in small water bodies which do not dry in summer, with strong sunlight and abundant vegetation. They are found with larvae of A. maculipennis, A. cinereus, C. alaskaensis and others. In the south they occur only in shaded water bodies, sometimes in springs and swamps. They feed on reptiles and amphibians. They usually do not bite people and farm animals.

333 Culex territans judaicus Edwards, 1926

It differs from the nominate subspecies in the shorter palps of the male, the length of the two apical segments, which are about half as long as the long 3rd segment (they are about $^2/_3$ as long in the nominate subspecies); long segment of palps of male without long hairs, terminal segments with thinner hairs, phallosome with indistinct tubercles at the apex. Small mosquitoes, wings about 3 mm long (about 4 mm in C. t. territans).

Distribution. Southwest Asia (Palestine).

6. Culex (Neoculex) hortensis Ficalbi, 1889

Closely related to C. (N) territans, differing in the light spot at the apex of the hind tibiae, the bare or nearly bare apex of the segments of the palps of the male and the structure of the hypopygium. Palps of female with light scales dorsally. The light transverse stripes on the abdominal tergites are usually broader than in C. territans and the stripes are sometimes triangularly produced anteriorly into the area with dark scales. The coloration of body and scales is usually paler.

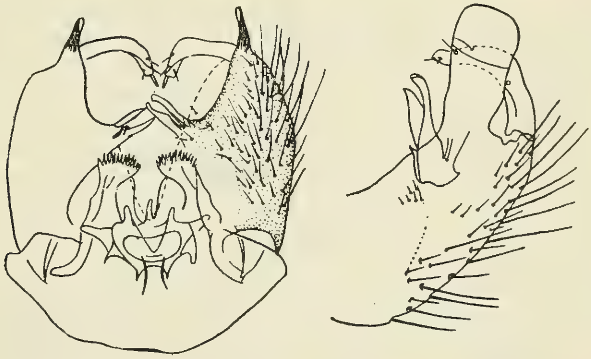

FIGURE 226. Hypopygium of Culex hortensis Fic. and distal part of coxite, lateral

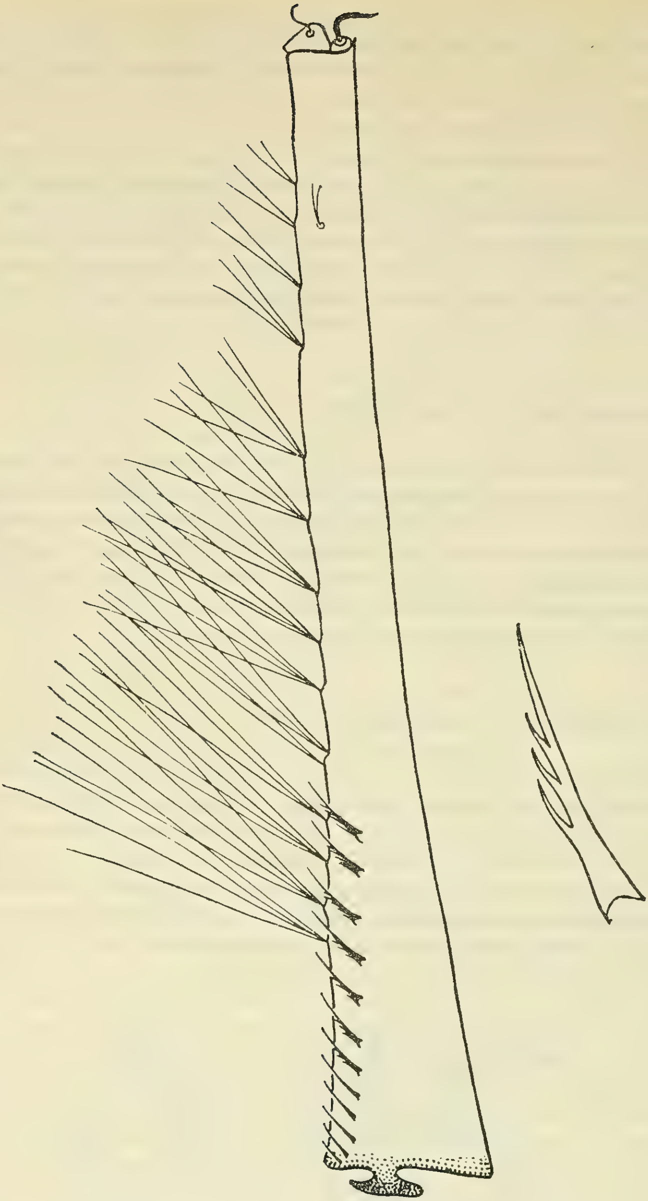

FIGURE 227. Culex hortensis Fic. Fourth-stage larva. Siphon, lateral.

Hypopygium (Figure 226): coxite with a broad, sclerotized, flattened process at the apex; spine shaped appendages of subapical lobe of coxite relatively short; plate-shaped appendage of lobe absent.

Fourth-stage larva (Figure 227) often not transparent, yellowish brown, cuticle covered with small chaetoids, which are denser on the mesothorax and metathorax.

Head more than 1.5 times wider than long. Antennae as long as the head, densely covered with spines, often darkly pigmented. Hair tufts with 25–35 secondarily feathered branches, $^3/_4$ as long as the antenna. Subapical setae situated a short distance before the apex. Frontal hairs: outer hairs with 7–12 branches, median hairs situated before the inner, slightly more widely spaced, both pairs with 2–4 longer and thicker branches.

Comb of 8th abdominal segment with 35–45 elongate scales with a row of spines at the margin of the slightly wider terminal part. Siphon long,
334 about 8 times longer than the width of the distinctly widened base. Pecten about $^1/_3$ of the length of the siphon, with 11–14 denticles. Nine to 12 hair tufts on the posterior surface of the siphon in a zigzag row, 2–4 basal tufts situated between the distal denticles of the pecten. The first 6–8 tufts are very long, the next become gradually shorter. There are also 1–2 pairs of shorter lateral tufts on the lateral surface of the siphon near the apex.
335 Main tracheal trunks thin, rounded; stigmal plate as in C. territans. Last segment long, with a ring-shaped saddle. Lateral hair with 2 branches. Fin with 12–14 tufts. Gills as long as the saddle or longer.

Distribution. Mediterranean. USSR: Crimea, Caucasus and Transcaucasia, Middle Asia (Turkmenia, Uzbekistan, Tadzhikistan), South Kazakhstan; Europe to Berlin in the north; West Asia (Asia Minor, Palestine, Syria, Iran); North Africa.

Biology. The larvae occur in fresh water with algae and vegetation, often together with larvae of Anopheles maculipennis, Culiseta longiareolata, C. annulata, Culex laticinctus Edw. and others. The mosquitoes rest during the day in caves and other dark places. They do not bite man often.

7. Culex (Neoculex) martinii Medschid, 1930

Very small mosquitoes. Coloration yellowish brown. Abdomen with uniformly colored scales dorsally. Proboscis and tarsi without light rings. Head pale; genae with white scales. Proboscis brown, slightly thickened in the apical third. Palps of female very short, brown; palps of male longer than the proboscis by about the length of the last segment, not thickened at the apex. Mesonotum yellowish, with small, golden brown scales and long, brown hairs. Femora and tibiae with dark scales anteriorly and light scales posteriorly. Wings with brown scales at the veins. Abdomen with brown scales dorsally and triangular whitish spots at the sides of the tergites which become wider toward the posterior margin of the tergites.

Hypopygium (Figure 228): coxite short and thick; lobe situated beyond middle of coxite, near the apex, lobe with 2 moderately long but very thick spines. Style short and broad, distinctly wider in the middle. Tenth sternite with broad, lobe-shaped lateral processes with small hairs and a row of narrow, blunt denticles which form a comb or a fringe at the apex.

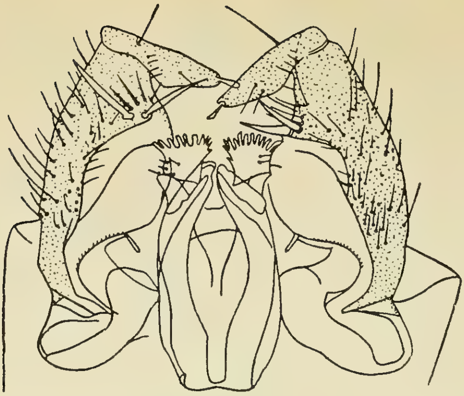

FIGURE 228. Hypopygium of Culex martinii Med.

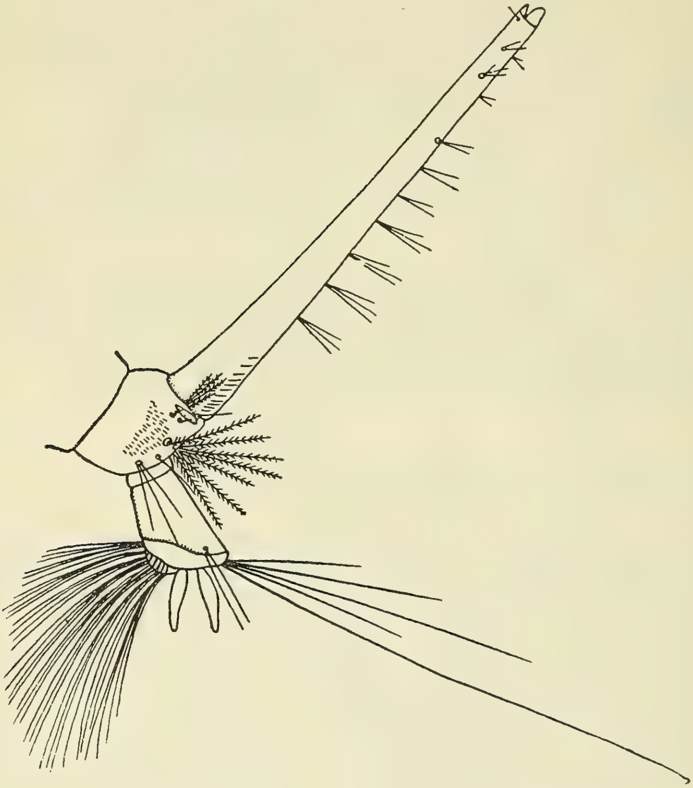

FIGURE 229. Culex martinii Med. Fourth-stage larva. Posterior end, lateral.

Fourth-stage larva (Figure 229): head 1.5 times broader than long. Antenna at least $^3/_4$ as long as the head, hair tuft with 22–26 secondarily feathered branches, 0.7–0.8 times as long as the antenna. Subapical setae as long as the tuft, situated a short distance before the apex. Outer frontal hairs usually with 5 branches, median hairs simple, rarely 2-branched, very long, reaching to the apex of the antenna or even beyond it, situated before the distinctly shorter, 2-branched inner hairs and more widely spaced than these. Comb with 35–40 small, markedly elongate scales with a row of spines at the margin and at the apex. Siphon very thin, long, 7.5–11 times longer than the width of the wide base, sometimes slightly widened at the apex. Pecten with 12–16 denticles in the basal $^1/_5$ of the siphon and with 3–5 accessory denticles. Ten to 12 hair tufts in a zigzag row at the sides of the posterior surface of the siphon and then in irregular pairs toward the apex, some of them situated on the lateral surface. Hair tufts short, with 2–5 branches, as long as the width of the siphon or slightly longer, apical tufts shorter. Tracheae thin, with round cross section; stigmal plate of the C. territans type. Last segment long, with a ring-shaped saddle. Lateral hair 2-branched. Outer caudal hairs simple, usually as long as the siphon, inner hairs 4-branched. Fin with 11–12 tufts. Gills about half as long as the saddle.

Distribution. Mediterranean. USSR: Middle Asia, Uzbekistan (Lisova, 1935 – "C. sp."), Tadzhikistan, Kirghizia. Balkans (Yugoslavia), Asia Minor (Anatolia).

Biology unknown.

8. Culex (Neoculex) hayashi Yamada, 1917

Small mosquitoes, differing from the other species of Culex in the relatively short palps of the male and the structure of the hypopygium. Proboscis and palps dark. Palps of male $^2/_3 - ^4/_5$ as long as the proboscis. Mesonotum brown, with narrow, reddish brown scales with a bronze sheen.
337 Tibiae and tarsi without light rings. Wings with dark scales. Abdomen with dark brown scales dorsally, without light stripes.

Hypopygium (Figure 230): subapical lobe of coxite with 4–5 closely spaced, narrow plates and 2–3 longer, rod-shaped appendages with hooked end. Right and left plates of phallosome connected by a bridge near the base, each plate broad and with denticles of different size on the surface and short, sclerotized processes directed anteriorly and inward. Tenth sternite with numerous spines in several rows at the apex. Lobes of 9th tergite weakly developed, with 4–6 hairs.

Fourth-stage larva (Figures 231–233) transparent but the brown fat body gives it an apparent transverse striation.

Head 1.6–1.7 times wider than long. Antennae with spines, nearly as long as the head, with dark base and narrow apical part. Hair tuft with
338 25–30 branches, subapical setae situated at the apex. Frontal hairs: outer hairs long, with 5–8 branches, median and inner hairs short, with 2–4 branches, nearly as long as the postclypeal hairs. Comb with 34–46 narrow, elongate scales with a row of spines in the apical part. Siphon 5.5–6 times
339 longer than wide at the base, slightly widened at the apex. Pecten with 10–13 regularly spaced denticles in the form of thin spines with a row of thin, pointed accessory denticles their entire length. Eleven to 13 hair

tufts, situated in a zigzag row on the posterior surface, a paired arrangement is exceptional. Tufts with 3–6 smooth branches, longer than the width of the siphon at their position. Main tracheal trunks thin, with round cross
340 section. Stigmal plate (Figure 233) resembling that of C. (N). territans but differing in some details (presence of a distally directed chaetoid at the end of the posterior process, structure of the organs on the lateral valves, etc.). Saddle of last segment ring-shaped. Lateral hair short, with 3–4 branches. Outer caudal hairs as long as the siphon, inner hairs shorter, with 2–5 hairs which are shorter dorsally. Fin with 12–13 tufts. Gills lanceolate, usually as long as the saddle, lower pair longer than the upper.

(337)

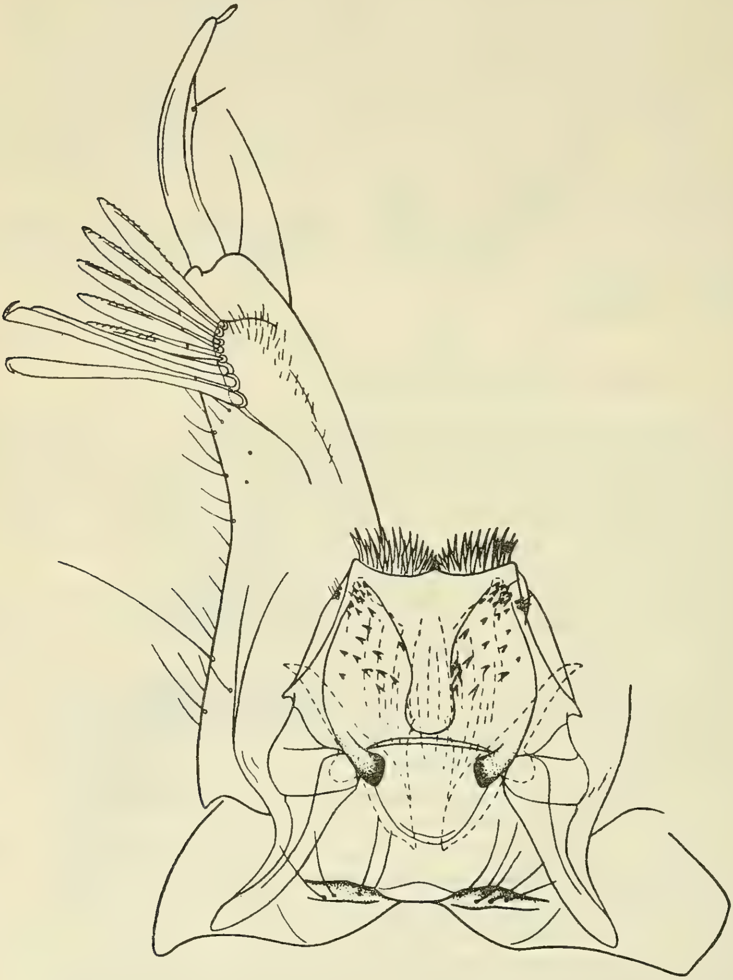

FIGURE 230. Hypopygium of Culex hayashii Yam. (after LaCasse and Yamaguti)

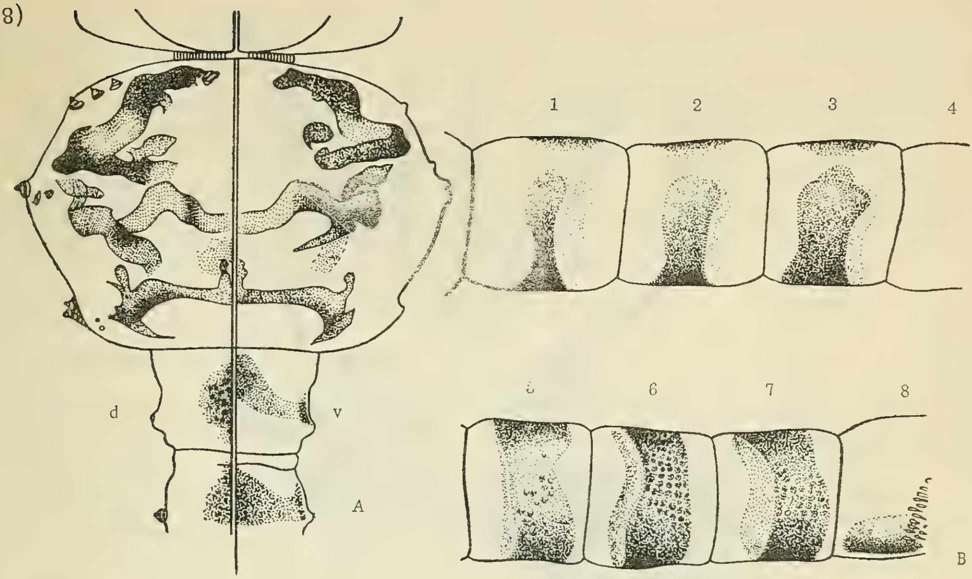

FIGURE 231. Culex hayashii Yam. Fourth-stage larva. Distribution of pigment in the fat body:
A — thorax and first two abdominal segments (d — dorsal and v — ventral); B - abdominal segments 1–8, lateral.

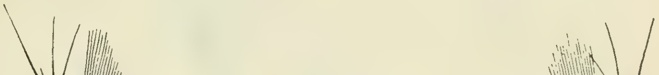

FIGURE 232. Culex hayashii Yam. Fourth-stage larva. Head, dorsal.

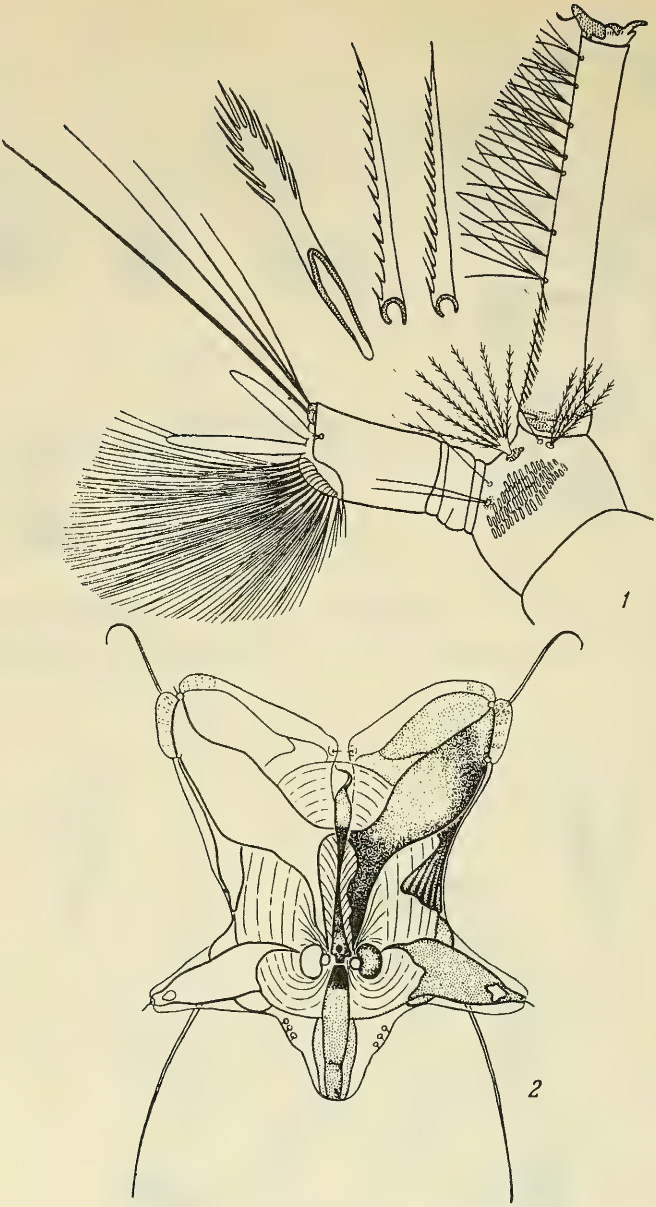

FIGURE 233. Culex hayashii Yam. Fourth-stage larva:
1 – posterior end, lateral; 2 – stigmal plate.

Distribution. USSR: southern Maritime Territory. Korea, China, Japan (Hokkaido, Honshu, Kyushu).

Biology. The larvae usually occur in small numbers from the end of spring to autumn, in shallow sunlit water bodies with decomposing leaves and with vegetation, also in reservoirs and cisterns together with A. hyrcanus, A. communis (spring), C. modestus, C. bitaeniorhynchus, C. tritaeniorhynchus, C. infantulus Edw. and C. vishnui Theob. They are found only in thinned forests in the foothills. They are not important bloodsuckers. A rare species.

4. Subgenus Culex Linnaeus

Coxite without scales; style usually simple, without subapical row of spines; 10th sternite with a tuft of dense hairs or spines at the apex and with a more or less developed appendage at the base in most species; phallosome of complicated structure, often with denticles or processes. Ninth tergite forming a narrow transverse stripe. Tarsi usually dark, rarely with light rings, which sometimes extend to the apex of the segment and the base of the next.

The larvae of the species of this subgenus vary in structure and can sometimes be characterized only by negative characters: absence of mouth parts adapted to predacious feeding, arrangement of the scales of the comb, which never form a regular row. The arrangement of the adults in groups does not correspond to the grouping of the larvae, which have not been sufficiently studied. The larvae of some species resemble those of species of Barraudius, and the larvae of C. mimeticus resemble those of the subgenus Neoculex.

The subgenus contains over 180 species which are divided into two groups according to the chaetotaxy of the pleurae of the thorax, and the structure of the hypopygium. The first group includes all Palaearctic species with light rings on the tarsi which are mainly Oriental and only a few species occur in Africa. This group is distributed mainly in the southeastern Far East of the Palaearctic (Maritime Territory) and a few species occur in the south (C. mimeticus). The Palaearctic species of the second group have dark tarsi without rings and are more closely related
341 to the Ethiopian species.* This group attains the highest specific diversity and many species are very closely related. C. pipiens, which occurs in many parts of the USSR, belongs to this group.

9. Culex (Culex) bitaeniorhynchus Giles, 1901

Closely related to C. sinensis, but differs from it in the presence of light and dark scales on the wings and in the structure of the hypopygium.

Head with narrow, light golden, contiguous and upright, forked scales in the middle of the vertex; lateral margins of eyes with broad, light, contiguous scales. Palps of female short, $1/5$ as long as the proboscis, with

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* This group contains numerous neotropical species, which resemble the Ethiopian species of the group.

dark scales; apex of palps of female with light scales. Palps of male distinctly longer than the proboscis (nearly by the length of the 2 terminal 342 segments); terminal segments with a ring of light scales at the base; long segment of palps with 2 light rings; terminal part ($^1/_2 - ^2/_5$) of apical segment light. Proboscis with a white ring beyond the middle. Mesonotum dark brown, with light yellow or golden, narrow scales in the anterior two thirds; two distinct, rounded spots of dark scales near the middle of the mesonotum with light scales; posterior third of mesonotum with dark scales. Pleurae of thorax with white scales on sternopleura and mesepimera. Legs brown; femora and tibiae with brown scales and with more or less numerous scattered white scales anteriorly; and mainly with white scales posteriorly; tarsi dark brown, with white rings at the base of tarsal segments 1–4. Wings with brown and yellowish scales. Abdomen brown, with more or less broad stripes of white scales at the apex of the tergites, sometimes also with indistinct, but much narrower stripes at the base of the tergites.

(341)

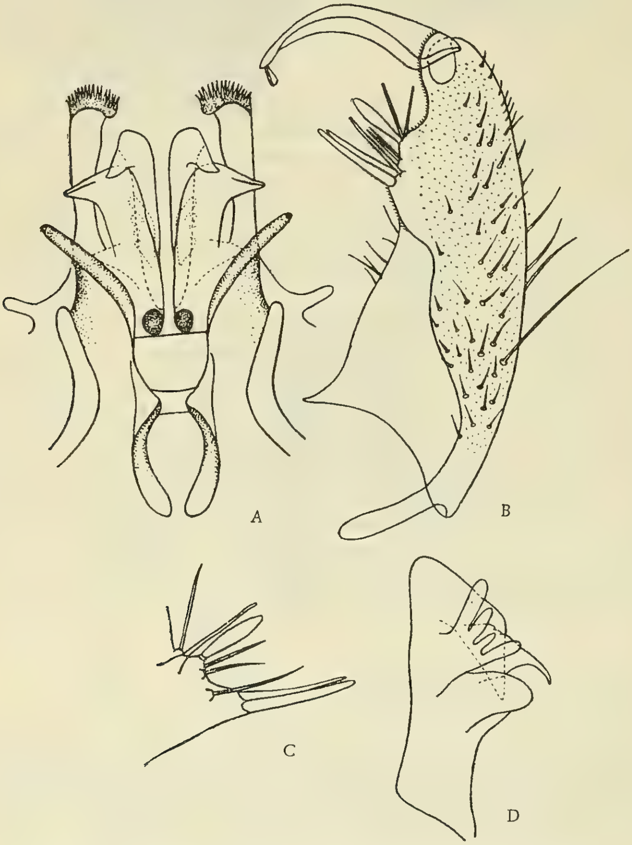

FIGURE 234. Hypopygium of Culex bitaeniorhynchus Giles:

A — inner sclerites; B — coxite and style; C — basal lobe of coxite; D — second part of phallosome.

Hypopygium (Figure 234) characteristic; plate on subapical lobe of coxite narrow, knife-shaped; phallosome with two, pointed, sickle-shaped plates at each side; at the sides of the phallosome is a process with 4 or 5 finger-shaped denticles; basal process of 10th sternite weakly developed.

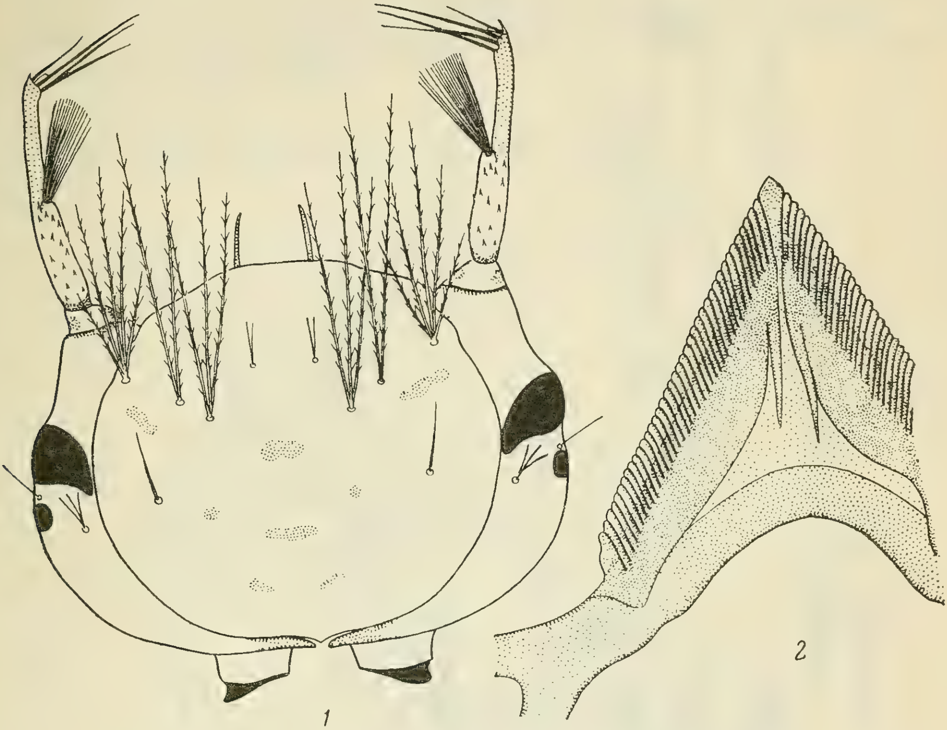

FIGURE 235. Culex bitaeniorhynchus Giles. Fourth-stage larva:
1 — head; dorsal; 2 — mentum.

Fourth-stage larva (Figures 235 and 236) at first transparent, 343 later green or brownish green. Head small, relatively narrow. Antennae situated anteriorly, rod-shaped, narrower from the middle, from the hair tuft, which has 15—25 branches; subapical setae directed inward, situated at the apex. Mouth parts adapted to feeding on filamentous algae. Lateral lobes of labrum with fewer than usual, curved hairs; mandibles and maxillae also modified; mentum forming an isosceles triangle with very small, regular incisions at the margin. Frontal hairs secondarily feathered, outer hairs with 4—7 branches, median hairs longer, with 2 branches, inner hairs with 3 branches. Comb with 4—7 large, spine-shaped scales. Siphon long, thin, 6—8 times as long as wide at the base. Pecten with 7—9 denticles at the base of the siphon. Four to 5 pairs of hair tufts on the

posterior surface arranged in a zigzag row, each with 2–5 short branches,
344 shorter than the width of the siphon. Saddle surrounding last abdominal segment like a ring. Lateral hair short, with 1–3 branches. Outer caudal hairs simple, shorter than the siphon, inner hairs with 3–4 branches. Fin with 12 tufts. Gills slightly longer than the saddle, lanceolate.

(343)

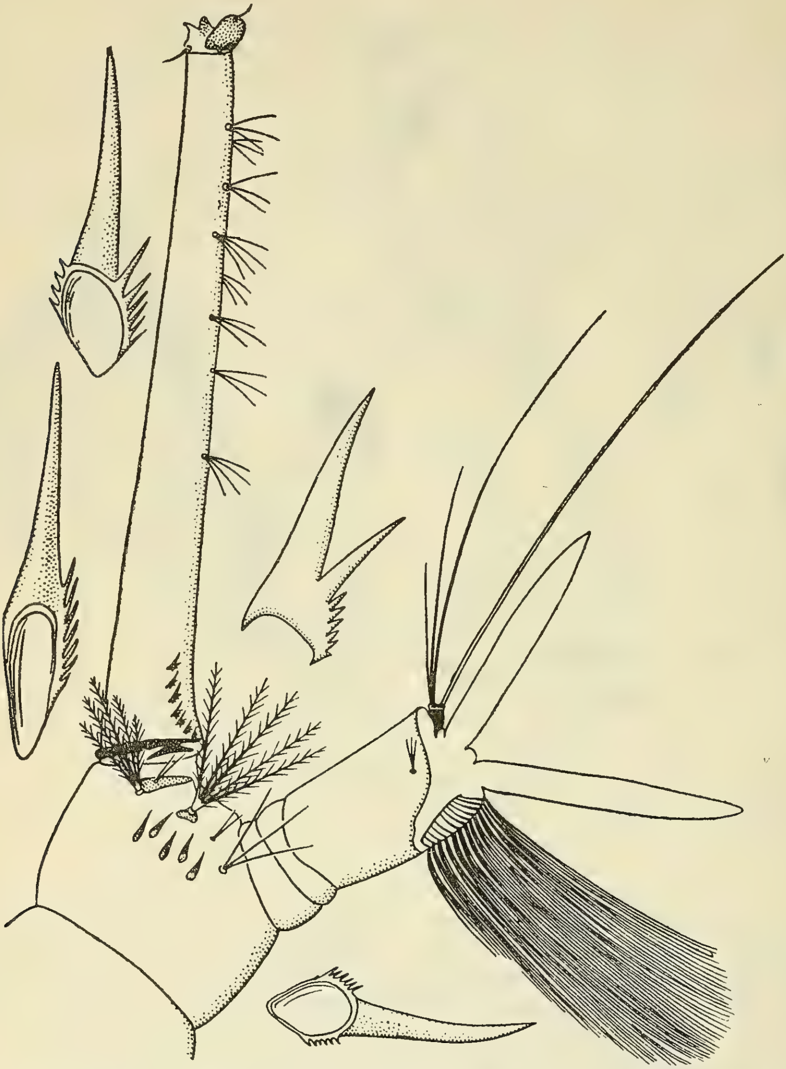

FIGURE 236. Culex bitaeniorhynchus Giles. Fourth-stage larva. Posterior end, lateral.

Distribution. USSR: southern Maritime Territory, to the Iman River in the north, where it is widespread in lowland and coastal areas. Japan, to Honshu, Korea, China, Southeast and South Asia, Africa, Northern Australia.

Biology. The larvae occur in large numbers in open, sunlit, stagnant or slowly flowing, pure water with abundant vegetation and filamentous algae. They are found together with larvae of A. hyrcanus, rarely with those of C. tritaeniorhynchus, C. vishnui, C. hayashii and others. They are active bloodsuckers which bite mainly at night in rice fields.

345 Epidemiological importance. According to Japanese authors (Yamaguti and La Casse, 1955) it is considered as a vector of Japanese encephalitis. Specimens of this species have been infected with this virus (Petrishcheva and Shubladze, 1940).

10. Culex (Culex) sinensis Theobald, 1903

(344)

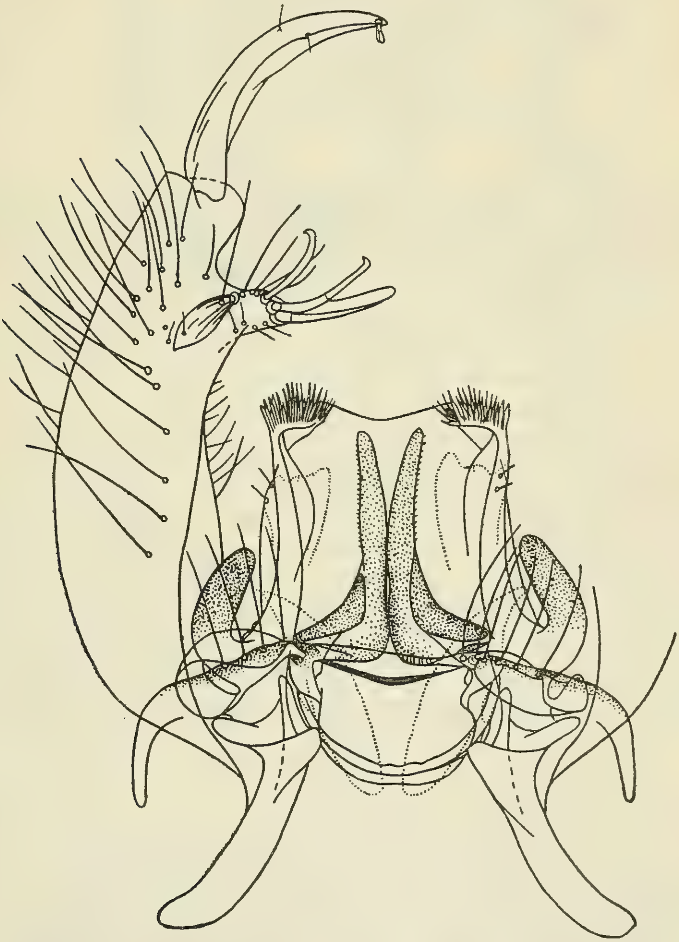

FIGURE 237. Hypopygium of Culex sinensis Theob. (after La Casse and Yamaguti)

It resembles C. bitaeniorhynchus in coloration but differs from it in the brown scales on the wings (without light scales) and in the structure of the hypopygium.

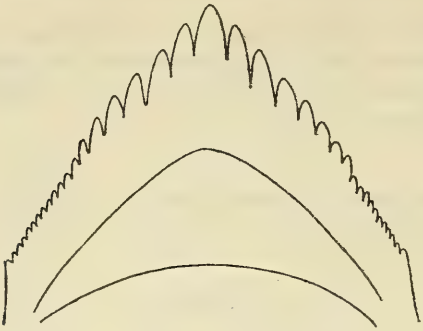

FIGURE 238. Culex sinensis Theob.
Mentum of larva (after Barraud)

The white scales on the legs usually form small, slightly irregularly arranged spots (not a regular row of spots). Tarsi with narrow white rings at the base of the segments; abdomen with stripes of light scales at the base of the tergites.

Hypopygium (Figure 237) resembling that of C. bitaeniorhynchus; plate of subapical lobe of coxite narrow, lanceolate; phallosome with a pair of simple (not segmented or serrated), slightly curved plates; basal processes of 10th sternite large, markedly sclerotized.

Larva resembling that of C. bitaeniorhynchus, differing as follows: subapical setae of antenna situated distinctly before the apex; mentum (Figure 238) with larger denticles in the middle; comb with 4–6 large scales with a pointed spine; pecten with 2–4 small denticles at the base of the siphon; a large, slightly curved, spine-shaped hair on the anterior surface near the apex of the siphon; gills 2.5 times longer than the saddle, inner caudal hairs with 2 branches.

Distribution. Mainly in the Oriental region. USSR: southern Maritime Territory. Japan (Honshu, Kyushu), Korea, China, Southeast and South Asia.

Biology. The larvae occur in rice fields and on swampy meadows.

11. Culex (Culex) whitmorei Giles, 1904

The species has a distinctly two-colored mesonotum which is covered with white scales in a large part, posterior third with dark scales; proboscis and tarsi with white rings; wings with broad dark scales on the anterior veins and on the cubitus, with a spot of dark scales at the base of r_{4+5}.

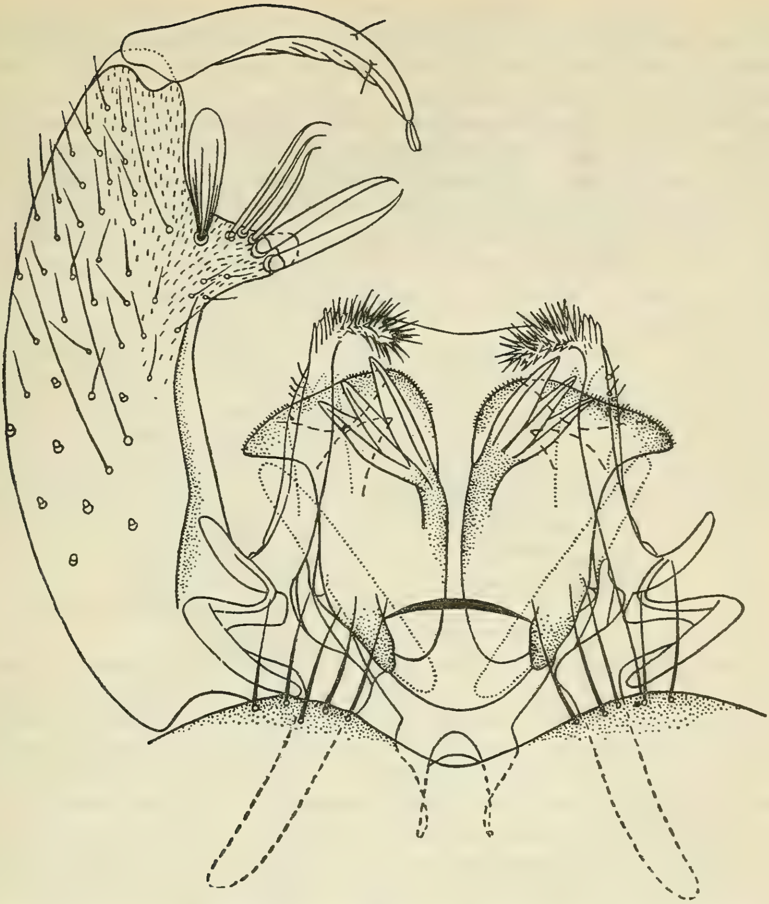

FIGURE 239. Hypopygium of Culex whitmorei Giles (after La Casse and Yamaguti)

Greater part of head with white scales. Proboscis dark brown at the base and in the apical part, with a distinct yellowish white ring in the middle. Palps of female $^1/_5$ as long as proboscis, with brown and white scales; base of palps and base of 3rd segment of palps with white scales; palps of male 1.5 times longer than the proboscis, blackish brown; apex and base of 5th segment of palps and base of 4th segment with white scales; the more or less broad but indistinct ring in the middle of the 3rd segment and apex of 2nd segment light; hairs on palps numerous, long, dark brown. Mesonotum brown, its anterior two-thirds with white scales, with a golden, kidney-shaped spot or 3 small spots near the middle; posterior third of mesonotum with dark golden scales and setae and with some white scales. Legs: femora and tibiae mainly with brown scales and a few white scales anteriorly; tarsi with narrow white rings at the base of segments 1–4. Wings with brown scales; costa, subcosta, r_1, r_{4+5} and cubitus with broad, dark scales. Abdomen with light stripes or triangular spots of white scales which extend posteriorly from the base of the tergites; tergites 5—8 with more or less large spots of white scales at the sides; ventral side brown, with stripes of light scales.

347 Hypopygium (Figure 239): subapical lobe of coxite with a broad plate, 2 rod-shaped appendages, one of them thin and pointed and the other thick and blunt, and with setae; 10th sternite with a short, narrow basal process; apical part of phallosome with well developed median part which forms a hook and a broad, triangular lateral plate; lower part of phallosome normally with 4 denticles of more or less the same size.

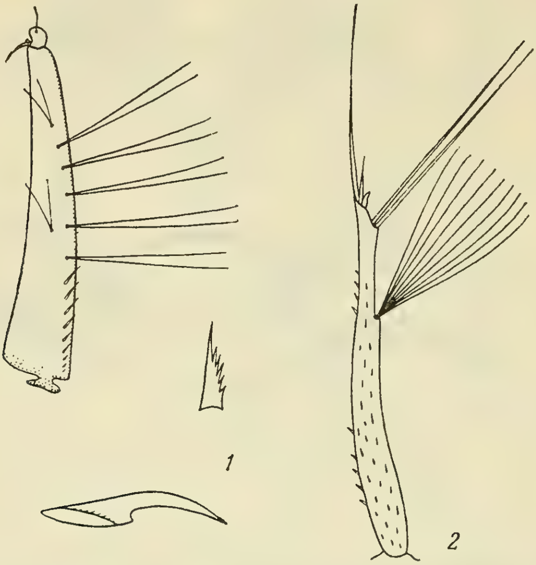

FIGURE 240. Culex whitmorei Giles. Fourth-stage larva (after Barraud):

1 — siphon, lateral; 2 — antenna.

Fourth-stage larva (Figure 240): head nearly 1.5 times wider than long. Frontal hairs secondarily feathered, outer hairs with 6—10 branches, median hairs situated slightly posterior to and inward of the outer hairs, both pairs long, 2-branched, one of them rarely 3-branched. Postclypeal hairs short, thin, 2-branched, rarely simple. Sutural and transsutural hairs slightly longer, with 3 or more branches. Antennae as long as the head, covered with spines. Hair tuft with 10 or more branches, situated beyond the middle of the antenna, which is narrow distal to the tuft. Two subapical setae.

Comb with 5—8 scales with a large main spine in an irregular, zigzag row, lateral spines at base of scales weakly developed, practically absent.

Hairs behind the comb: dorsal hair with 3–5, ventral hair with 2–3 branches, median hair with 6–8 branches, intermediate hair simple. Siphon wider at the base and then tapering, index 5.0–6.0. Pecten with 6–10 thin denticles, the 1–2 distal denticles larger and more widely spaced, occupying the basal part of the siphon, not reaching third of siphon from the base; 4–6 pairs of hair tufts in one row in the middle of the posterior surface of the siphon. Tufts with 2 long, slightly secondarily feathered branches and also with 2 pairs of much shorter, 2-branched tufts on the lateral surfaces, one in the middle, the other distal to the distal ventral tuft. Main tracheal trunks thin, with round cross section.

Last segment distinctly longer than wide; saddle surrounding the segment like a ring. Lateral hair simple, 2-branched. Caudal hairs longer than the siphon, simple or 2-branched. Fin with 12 tufts. Gills lanceolate, of varying length, as long as the saddle to as long as the siphon.

Distribution. Southern Maritime Territory. Japan (Kyushu, Honshu – rare), Korea, East and Southeast Asia.

348 Biology. Not studied in detail. The larvae occur in stagnant or slowly flowing water, in rice fields, etc. Mass attacks on man and domestic animals have not been observed.

12. Culex (Culex) mimeticus Noé, 1899

A very characteristic species, with spotted wings, slightly resembling A. superpictus (Figure 241) in habitus.

Head with yellowish white and brown scales. Proboscis blackish brown, with a broad white ring near the middle in females which is slightly narrower in males. Palps of female with blackish brown scales, apex of palps usually with white scales; palps of male blackish brown with blackish brown scales, usually with 3 white rings; proximal ring on the long segment of the palps distinctly wider than the other rings; apex of palps of male light. Antennae brown in both sexes, with light rings in the male. Mesonotum with light or golden brown scales in the middle, grayish or whitish scales at the margins; pleurae of thorax with spots of white scales. Legs: femora and tibiae with blackish brown scales anteriorly, often with some white scales which sometimes form a narrow longitudinal stripe, with white scales posteriorly; tarsi with narrow white rings at the base of segments 1–4; rings partly extending to apex of preceding segment. Wings with blackish brown scales on the veins, with 3 large white spots at the anterior margin, situated at the beginning and end of the median third of the anterior margin and near the apex and occupying veins c, sc and r_1; larger parts with white scales at the base of the forks $r_2 + r_3$ and $m_1 + m_2$ and on r_{4+5} (this vein is covered with white scales in a large part), m_{3+4} and an; cu_1 only with blackish brown scales. Abdomen dark brown, with black scales dorsally; tergites with transverse stripes of white scales at the base, usually a third as wide as the tergite, ventral side with white scales.

Hypopygium (Figure 242): coxite with relatively short hairs; subapical lobe of coxite with a broad, leaf-shaped, platelike appendage and usually with 5 large setae; style tapering apically; 10th sternite with a basal appendage; lower part of phallosome with 3–5 laterally directed denticles.

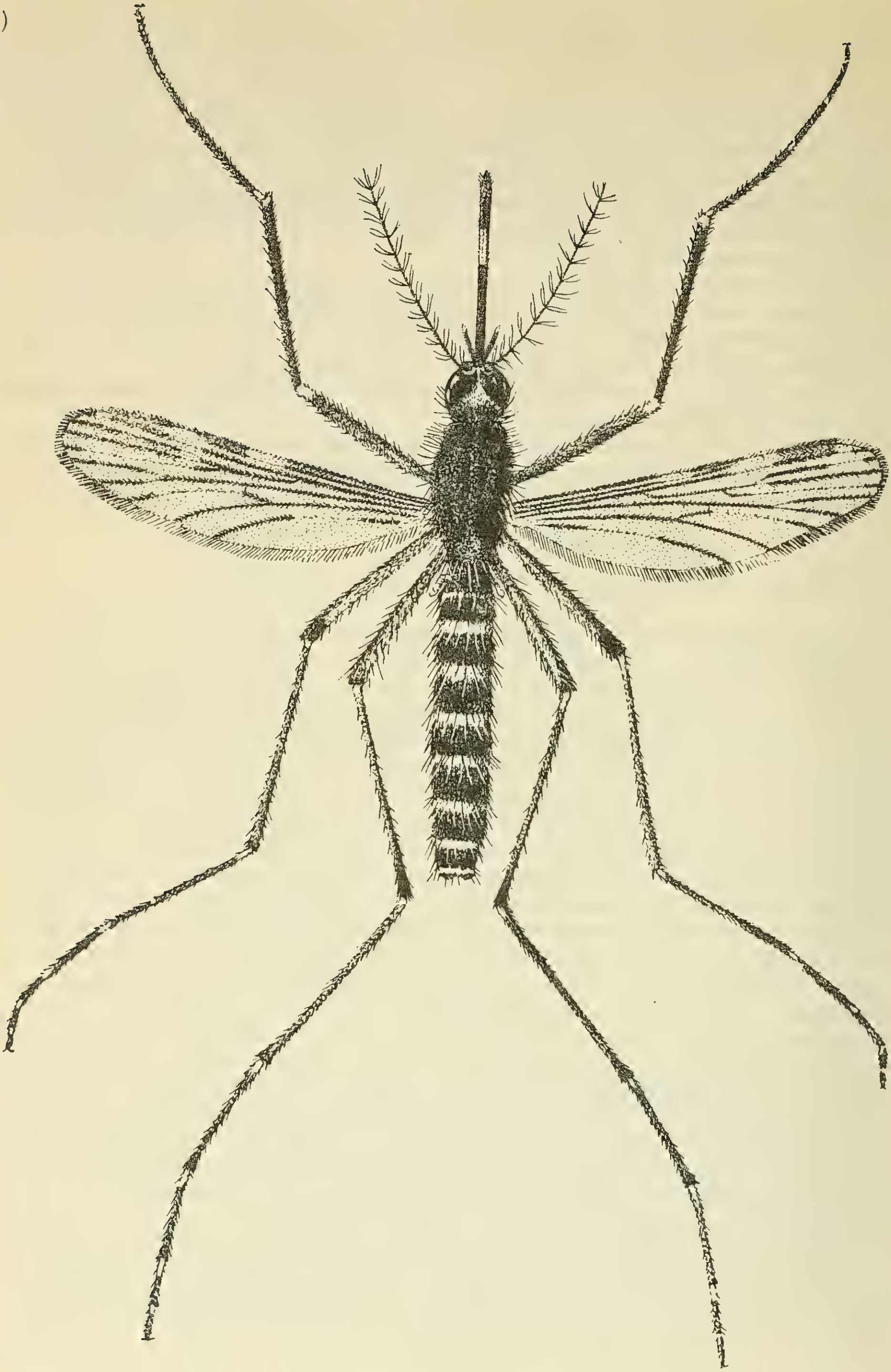

FIGURE 241. Culex mimeticus Noé

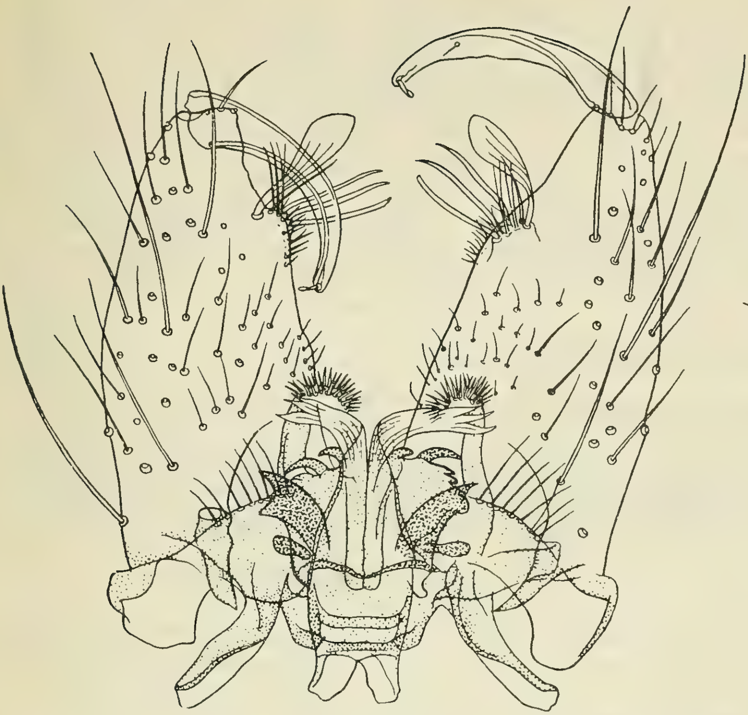

FIGURE 242. Hypopygium of Culex mimeticus Noé

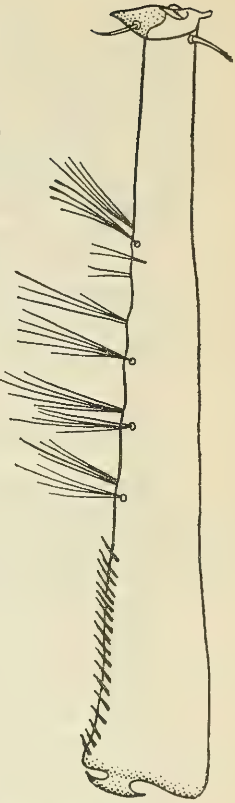

FIGURE 243. Culex mimeticus Noé. Fourth-stage larva. Siphon, lateral

Larvae (Figure 243) resembling those of the subgenus Neoculex in many characters.

Head very broad, often dark; median frontal hairs situated before the inner hairs, more widely spaced; both pairs with 2 secondarily feathered branches. Antennae light, apex darker, with spines for $^2/_3$ from the base; hair tuft with numerous secondarily feathered branches, half as long as the antenna, situated in the middle or nearer to the apex. Subapical setae as long as the tuft, situated in middle of apical narrow part of antenna. Abdomen: comb with 20–35 scales, with a distinct, pointed main spine and a row of small spines at the sides of the base. Siphon straight, wider at the base and tapering apically; index 4.5–7, varying according to the width of the base. Pecten about $^1/_3$ as long as the siphon, with 12–13 denticles, the 1–2 distal denticles may be larger and more widely spaced. Five to 6 hair tufts, the first 3–4 pairs longer, with 4–5 branches, often arranged
350 in a zigzag row, irregularly spaced; the next pair of tufts with 2 thin, shorter branches, situated more laterally.

Main tracheal trunks thin, with round cross section. Stigmal plate of the C. territans type. Last segment with simple outer caudal hairs about as long as the siphon, inner hairs with 2 branches, the dorsal branch half as long as the ventral and with a short, 2-branched lateral hair. Fin with 12 tufts. Gills 1.5–2 times as long as the saddle, pointed at the end.

Distribution. South of the Palaearctic and Oriental region. USSR: Northern Caucasus, Dagestan, Transcaucasia, Middle Asia (Turkmenia, Tadzhikistan), Maritime Territory. Southern Europe, Asia Minor, Iran, India, China, Japan and other countries in Asia.

Biology. The larvae occur in small pools in crevices in rocks and in backwaters of rapidly flowing mountain streams overgrown with vegetation, sometimes together with larvae of A. marteri, A. claviger, A. superpictus and Culiseta longiareolata.

13. Culex (Culex) jacksoni Edwards, 1934

The adults closely resemble C. mimeticus, but the larvae differ distinctly.

351 According to the description, the mesonotum is covered with reddish brown scales, with lighter scales at the sides and in the area before the scutellum. Otherwise, including the structure of the hypopygium, as in C. mimeticus.

Fourth-stage larva greenish (young) to yellowish brown (older), medium-sized (to 1 cm).

Head about 1.5 times longer than wide. Frontal hairs with well developed secondary feathering, outer hairs with 6–12 (average 8) branches, longer than the median and inner hairs, with 2–6 (average 3) and 3–7 (average 5) branches respectively. Postclypeal hairs short and thin, with 2–3 (1–5) branches; sutural and transsutural hairs slightly longer, with 3–4 (1–5) thin branches.

Antennae slightly shorter than the head, only slightly curved, weakly pigmented at the base and with dense, thin, hairlike setae; distal part dark, narrower, with sparse, short, thick spines. Hair tuft forming a fan with 11–26 (average 18) secondarily feathered branches reaching to the end of the antenna. Two long subapical setae, the apical setae as long as these but slightly thinner.

Comb of 8th abdominal segment with 19–40 (average 32) pointed scales which form an irregular spot. Scales with a row of marginal spines at the sides of the base, spines near the main spine shorter than this. Hairs behind comb: dorsal hair with 5, ventral hair with 4, median hair with 7 secondarily feathered branches; intermediate hair smooth and simple.

Siphon long, slightly wider at the base (index about 6). Pecten with 8–20 (average 14) denticles, 2–4 rudimentary denticles at the base. The denticles are thin spines with several accessory denticles at the slightly widened base; all denticles weakly pigmented. Pecten occupying $\frac{1}{3}$ to half of the length of the siphon, rarely more. One to 5, often 3 of distal denticles longer and more widely spaced. At the posterolateral surface of the terminal quarter of the siphon are additional, larger, smooth spines, directed apically in the continuation of the pecten. This is a distinctive character of the larvae. The number of these spines varies from 9 to 2 (average 4, i. e., two pairs). If there are fewer spines, some may be rudimentary: a small, short spine on a broad base.

The number of hair tufts on the siphon is relatively constant: 3 pairs on the posterior surface in an irregular zigzag row; 1–2 basal tufts are situated near or between the 1–2 distal denticles and the apical tufts are situated between the additional spines. Tufts short, usually as long as the width of the siphon at their position, with 2–6 smooth branches. Two pairs of short, 2-branched (rarely simple) hairs on the lateral surface of the terminal quarter of the siphon.

Main tracheal trunks broad, ribbon-shaped. Stigmal plate of the "pipiens" type.

Last segment short, only slightly longer than wide. Saddle surrounding the segment like a ring. Lateral hair thin, short 2–3-branched. Caudal hairs: outer hairs simple, usually as long as the siphon, inner hairs $^3/_4$ as long, with 2, rarely 3 branches, rarely simple. Fin situated toward posterior margin of segment, with 12 tufts. Gills lanceolate, pointed at
352 the ends, both pairs of nearly the same length, 1.25–1.5 times as long as the saddle, rarely longer or shorter.

Biology. The larvae were found in shallow swamps with filamentous algae (Suchans District; A. I. Lisova) and in small pools and backwaters of streams (Furugel'ma Island; V. K. Trasis), mainly in foothills, together with larvae of A. hyrcanus, A. vexans, C. bitaeniorhynchus, C. mimeticus, C. modestus, C. vagans and others.

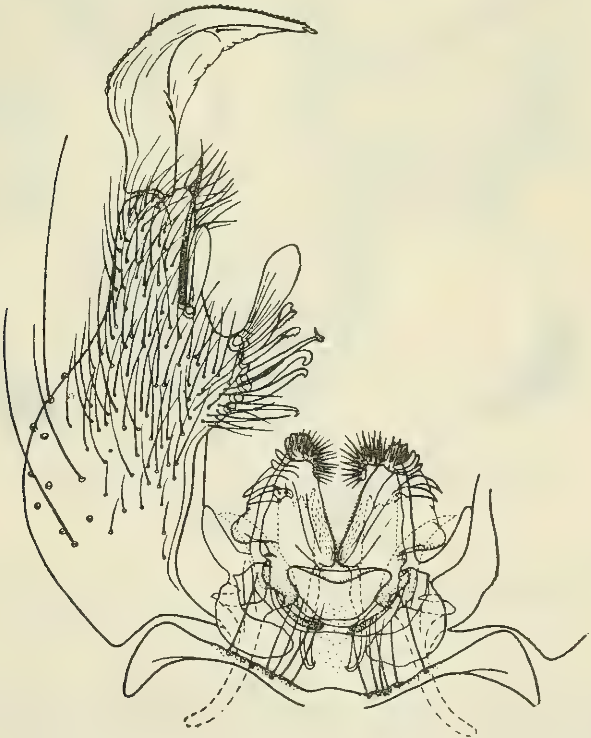

FIGURE 244. Hypopygium of Culex orientalis Edw.

14. **Culex (Culex) orientalis** Edwards, 1921

Closely related to C. mimeticus, but differs from it as follows: wing scales longer and the wings therefore appear more densely covered with scales; cu_1 with light scales at the apex; the part covered with light scales passes over to the stem of $m_{3+4} + cu_1$; palps of male with numerous light scales at the apex which are sometimes more numerous than the dark scales.

(353)

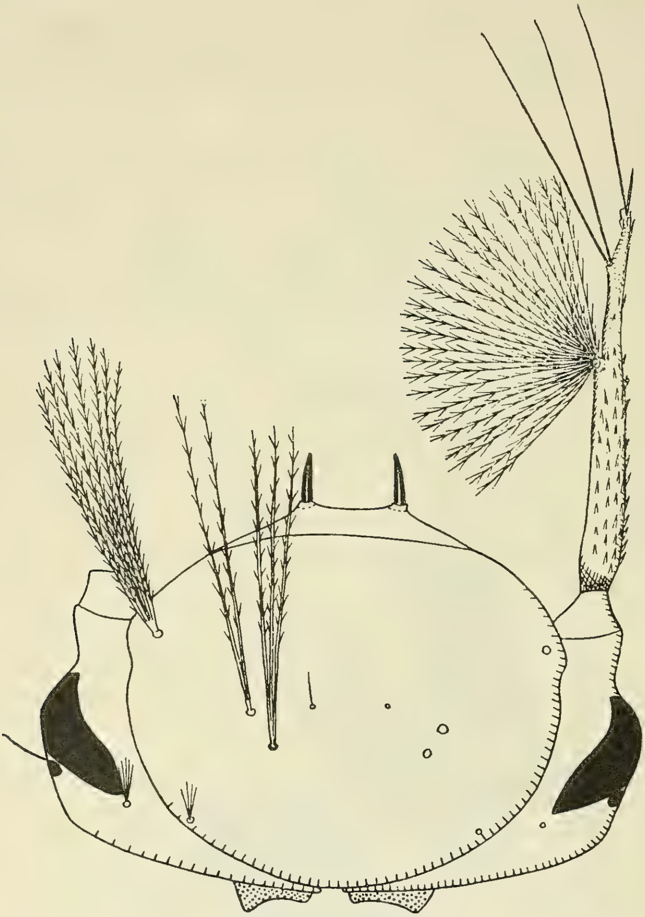

FIGURE 245. Culex orientalis Edw. Fourth-stage larva. Head, dorsal.

Hypopygium (Figure 244): coxite broad, slightly thickened, densely covered with hairs, especially in the apical part near the subapical lobe, which bears a transparent plate and a row of spines which are slightly denticulate or curved at the apex and surrounded by long hairs; style markedly widened in the middle, pointed apically; second part of phallosome with 3 large and several small denticles; the hypopygium differs from that of C. mimeticus in the presence of dense hairs in the apical part of the coxite.

353 Fourth-stage larva (Figures 245–247) semitransparent, becoming yellowish or green before pupation.

(354)

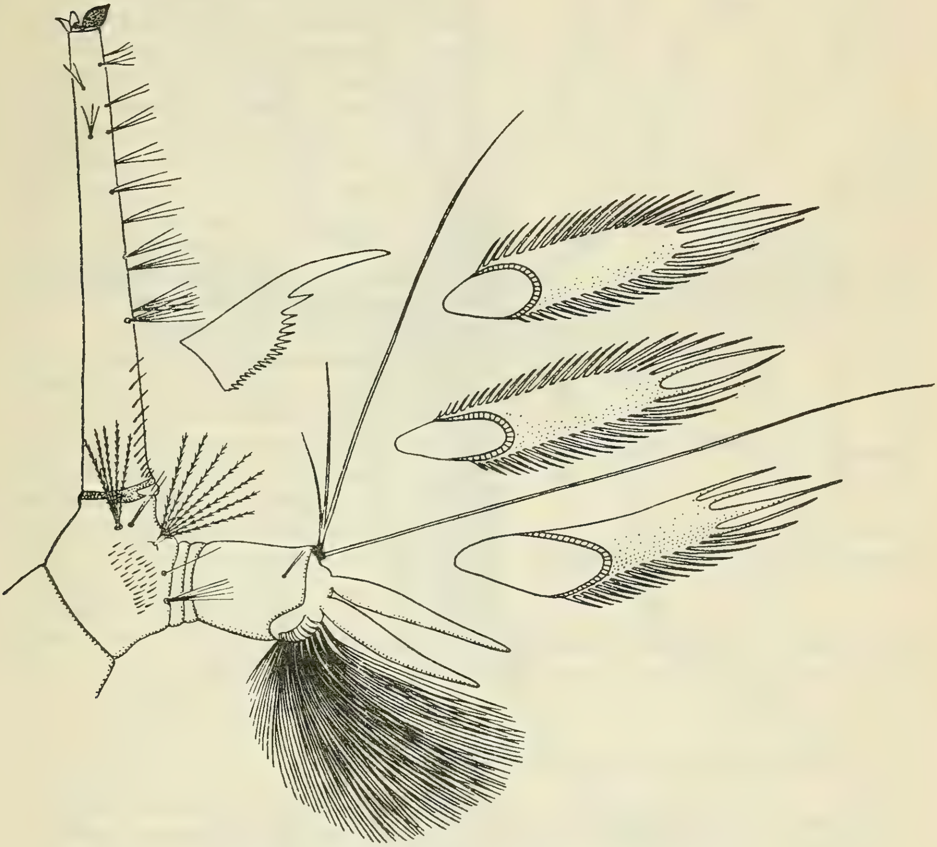

FIGURE 246. Culex orientalis Edw. Fourth-stage larva. Posterior end, lateral.

Head broad, light yellow. Frontal hairs long, secondarily feathered, outer hairs with 5–10 branches, median and inner hairs displaced posteriorly, the median hairs more widely spaced, with 2 branches, inner hairs with 3–4 branches. Antennae long, more than $^3/_4$ as long as the head, pigmented at the base and in the apical part; tuft with 20–35 secondarily feathered branches, half as long as the antenna, situated distinctly beyond the middle; subapical setae longer than tuft, situated at $^1/_3$ of the length of the terminal part from the apex, apical seta shorter.

(355)

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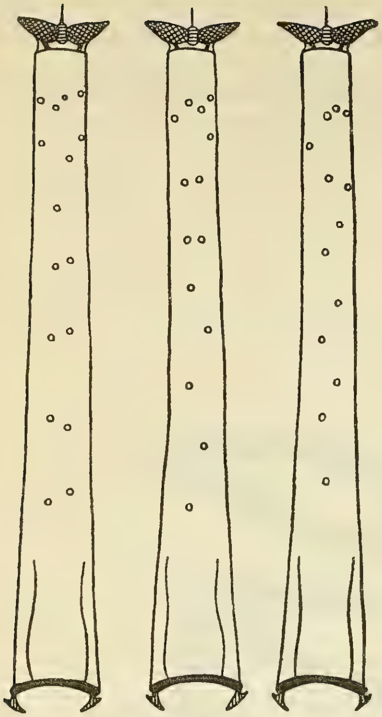

FIGURE 247. Culex orientalis Edw. Fourth-stage larva. Variation of arrangement of hairs on the siphon.

Comb with 20–40 (average 30) scales, with a row of spines at the margin which are distinctly larger at the apex. Siphon long, thin (index 6.2–7.9). Number and arrangement of hair tufts varying; 10–13 tufts on the posterior side arranged in pairs or in a zigzag row; basal tufts longer, slightly longer than the width of the siphon, with 2–5 branches; at the lateral surfaces, near the apex, are 1–2 pairs of tufts; all tufts near the apex short. Pecten with 9–14 denticles, 1–4 rudimentary denticles at the base. Main tracheal trunks with oval cross section. Stigmal plate of the C. pipiens type. Last segment with long, simple outer caudal hairs (1.3–1.5 times as long as the siphon), inner hairs $\frac{1}{4}-\frac{1}{3}$ shorter with 2–4 branches. Fin with 11–13 tufts. Gills lanceolate, as long as or longer than the saddle (to 1.7 times its length); lower pair shorter.

Distribution. East Asia. USSR: Khabarovsk and Maritime territories but not in the mountain-taiga. Japan, Korea, China, Philippines.

Biology. The larvae occur mainly in sunlit water bodies with rich vegetation and algae, in ditches and rice fields, often together with larvae of A. hyrcanus, C. bitaeniorhynchus, C. tritaeniorhynchus, A. vexans and others. Two, rarely three, generations per year. They have not been reported to bite man or domestic animals.

15. Culex (Culex) tritaeniorhynchus Giles, 1901

The species is characterized by a light ring on the proboscis, light rings on the tarsi and the absence of light scales on the wings (Figure 248).

355 Head with reddish brown scales. Proboscis with a white ring which sometimes extends nearly to the base in the female, particularly on the ventral surface. Palps of female dark, palps of male with 2 rings on the long segment, one ring distinctly wider than the other; apex of palps of male dark. Mesonotum with dark reddish brown scales. Femora and tibiae with brown scales; ventral surface of femora with whitish scales. Tarsi brown, with narrow, white rings at the base of the segments; rings sometimes indistinct, more distinct on the fore tarsi. [Abdomen with dark scales dorsally and with light stripes at the base of the tergites.]

Hypopygium (Figure 249) resembling that of C. mimeticus. Subapical lobe of coxite with a leaf-shaped plate and 3–4 spines. Lower part of phallosome with 4–5 denticles on each side, some of them (usually the median) directed posteriorly (in distinction to C. mimeticus). Basal appendages of 10th sternite well developed.

Fourth-stage larva (Figure 250) nearly transparent, weakly pigmented.

(356)

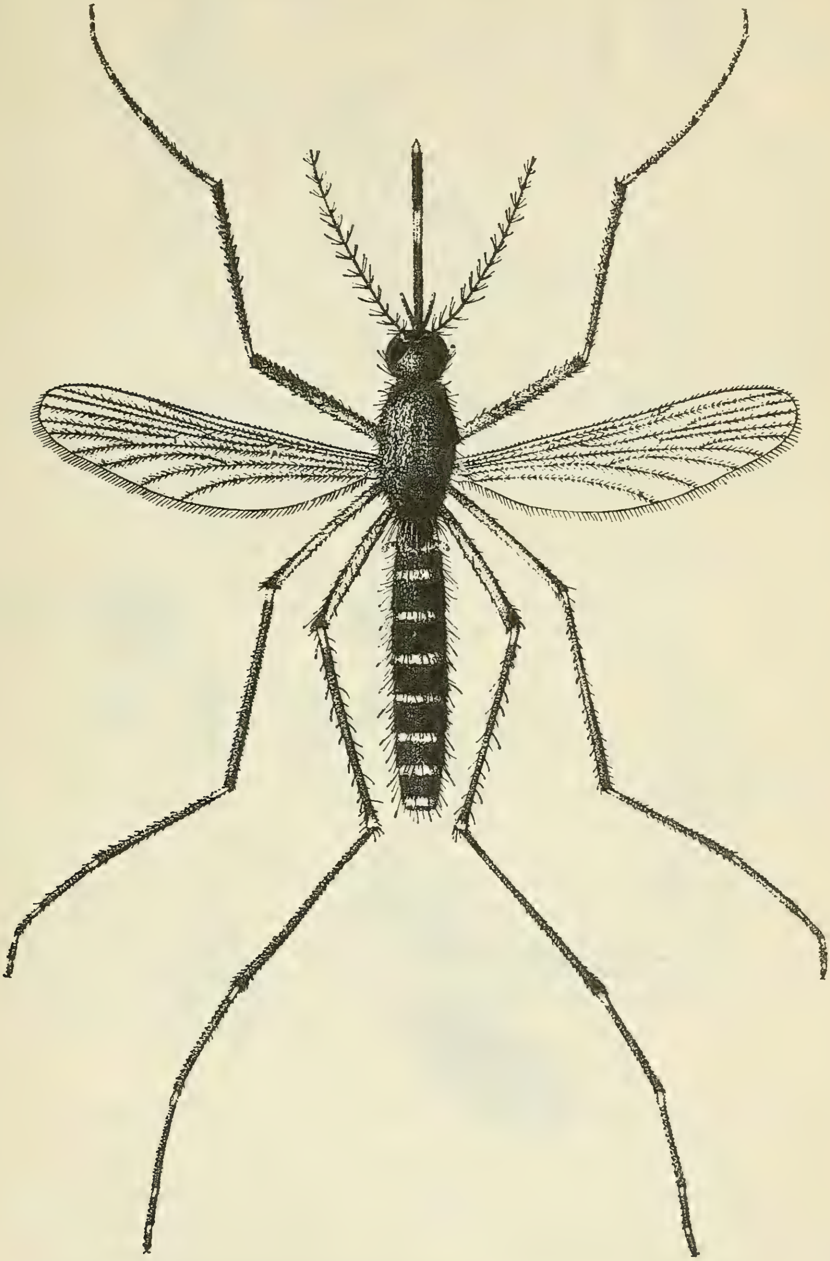

FIGURE 248. Culex tritaeniorhynchus Giles

(357)

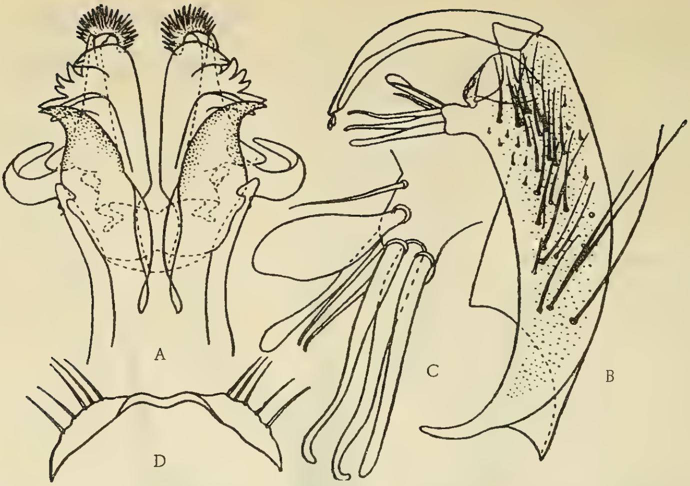

FIGURE 249. Hypopygium of Culex tritaeniorhynchus Giles:

A — inner sclerites; B — coxite and style; C — basal lobe of coxite; D — lobe of 9th tergite.

(357)

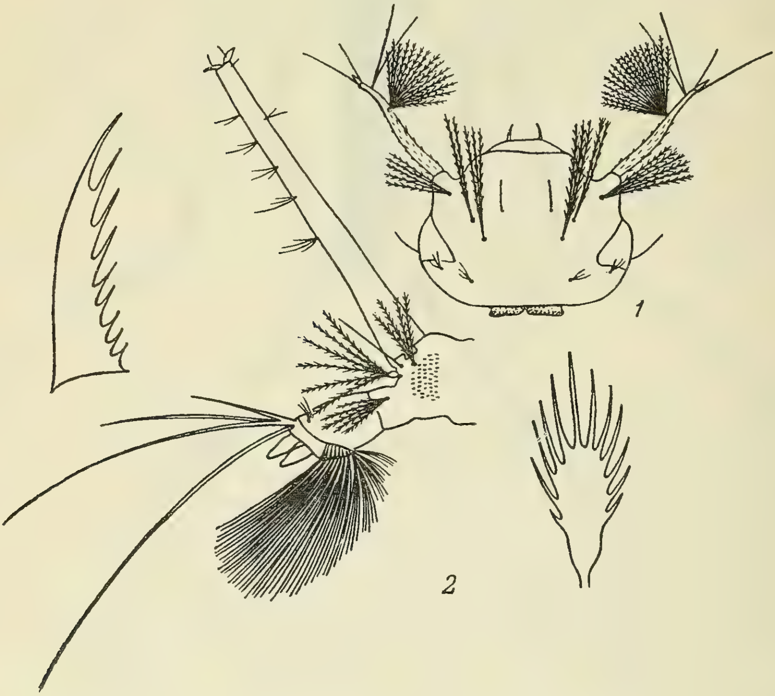

FIGURE 250. Culex tritaeniorhynchus Giles. Fourth-stage larva (after Kirkpatrick):

1 — head, dorsal; 2 — posterior end, lateral.

Head moderately broad, 1.3 times wider than long. Frontal hairs long, secondarily feathered, outer hairs with 6–8, median hairs with 2, inner hairs with 3 branches, situated more closely together than the median hairs. Antennae about 0.7 times as long as the head, dark at the base and with narrowing terminal part; tuft situated at about ⅔ of the length of the antenna from the base, with about 30 secondarily feathered branches. Subapical setae longer than the tuft, situated at about ⅓ the length of the narrow apical part before the apex; apical seta shorter.

Comb with about 50 short scales with a few spines at the margin which are longer at the apex. Siphon long (index 6.5–7.8) thin, with distinctly widened base; pecten with 9–15 denticles, the 2–3 distal denticles more widely spaced, with 5–9 thin, pointed accessory denticles on the entire ventral margin which are longer toward the apex. Five pairs of hair tufts at the sides of the posterior surface beginning at its second third from the base. Tufts with 3–4 branches (rarely 2, near the apex), not longer than the width of the siphon except the basal tufts; one pair of shorter, 2–3-branched lateral tufts in the apical third of the siphon. Tracheal trunks with oval cross section. Stigmal plate of the C. pipiens type. Last segment of abdomen with simple outer caudal hairs which are longer than the siphon, inner hairs with 3 branches, the lower as long as the siphon and each following branch half as long as the preceding, lateral hair short, 2–3-branched.
356 Fin with 12 tufts. Gills short, half as long as the saddle, pointed at the end, upper pair longer than the lower.

Distribution. The wide distribution includes the Oriental region, southern and southeastern parts of the Palaearctic and a large part of the Ethiopian region. It is found in the USSR in the southern part of Azerbaidzhan, in Turkmenia and Uzbekistan, and in the south of the Maritime
358 Territory (to the Iman River in the north.). It also occurs in Turkey, Iran, China, North Korea and Japan.

Biology. The larvae occur mainly in shallow, well warmed water bodies, which are sometimes only periodically flooded, and also on oxbow-lakes, where they are usually found only along the banks without vegetation. They usually inhabit meadow pools only after the hay harvest when the water is warmer. Their numbers are highest from the middle of July to the end of September. Active bloodsuckers, biting mainly in the open, usually from sunset to midnight or one in the morning and at 0600–0800 hr. In bad weather they may attack for days. They appear in inhabited areas near the breeding places and often enter houses and cattle sheds.

Epidemiological importance. This species is one of the main vectors of Japanese encephalitis. Transmission of the virus by bite and natural infection have been proved.

16. Culex (Culex) univittatus Theobald, 1901 (perexiguus Theobald, 1903)

It differs from related species in its small size, narrow, white, transverse stripes on the abdomen and in the presence of a more or less distinct white stripe on the anterior (outer) surface of the hind tibiae.

Head dorsally with brown and golden scales; white scales at the margin of the eyes. Proboscis brown, sometimes with white scales in the basal half.

Palps with brown scales, sometimes with an admixture of white scales at the apex in females. Mesonotum with golden brown scales, its lateral parts, the area before the scutellum and the scutellum with gray scales; pleurae of thorax with spots of white scales. Legs with brown scales; femora ventrally, hind femora also anteriorly in the basal half with white scales; hind tibiae and sometimes also mid-tibiae with a more or less distinct white longitudinal stripe on the outside; tarsi blackish brown. Veins of wing with brown scales. Abdomen dark brown and with dark brown scales; narrow transverse stripes of white scales at the base of the tergites.

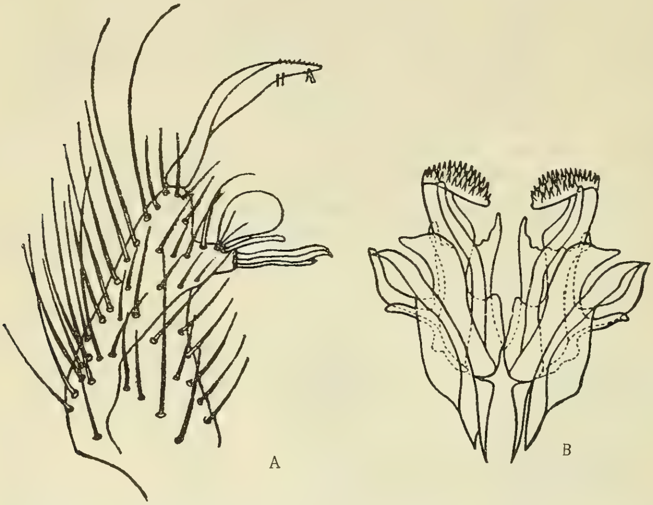

FIGURE 251. Hypopygium of Culex univittatus Theob.
A — coxite and style; B — inner sclerites.

359 Hypopygium (Figure 251): subapical lobe with a broad, asymmetrical plate; style distinctly widened beyond the middle; basal appendage of 10th sternite well developed; second part of phallosome broad, simple.

Fourth-stage larva (Figure 252) weakly pigmented, nearly transparent. Head 1.4 times wider than long. Frontal hairs secondarily feathered, outer hairs with 7–9, median hairs with 2–3, inner hairs with 3–4 branches; median hairs situated before the inner hairs, more widely
360 spaced. Antennae less than $^3/_4$ as long as head, with a tuft of 24–28 secondarily feathered branches, situated at $^2/_3 - ^3/_4$ of the length of the antenna from the base. Subapical setae situated near the apical seta.

Comb with 30–40 narrow, elongate scales, their distal end with a row of dense spines at the margin. Siphon (index 5.9–7.6) of varying length, the larger index corresponds to larger specimens. Pecten with 10–12 large denticles, occupying the basal $^1/_4$ of the siphon; the distal denticles may be widely spaced. Five pairs of tufts at the posterolateral surface of the siphon, with 2–4 branches, not longer than the width of the siphon;

the length of the tufts and their branching decrease toward the apex. The tufts are situated gradually more laterally toward the apex. One of the two tufts near the apex is situated on the lateral surface of the siphon and the other on the posterior surface. Main tracheal trunks broad, with oval cross section. Stigmal plate of the C. pipiens type. Last abdominal segment with simple outer caudal hairs which are as long as the siphon, inner hairs with 2 branches, lateral hair with 2–3 branches. Fin with 12 tufts. Gills 0.75–1.5 times as long as the saddle, oblong, ovoid.

(359)

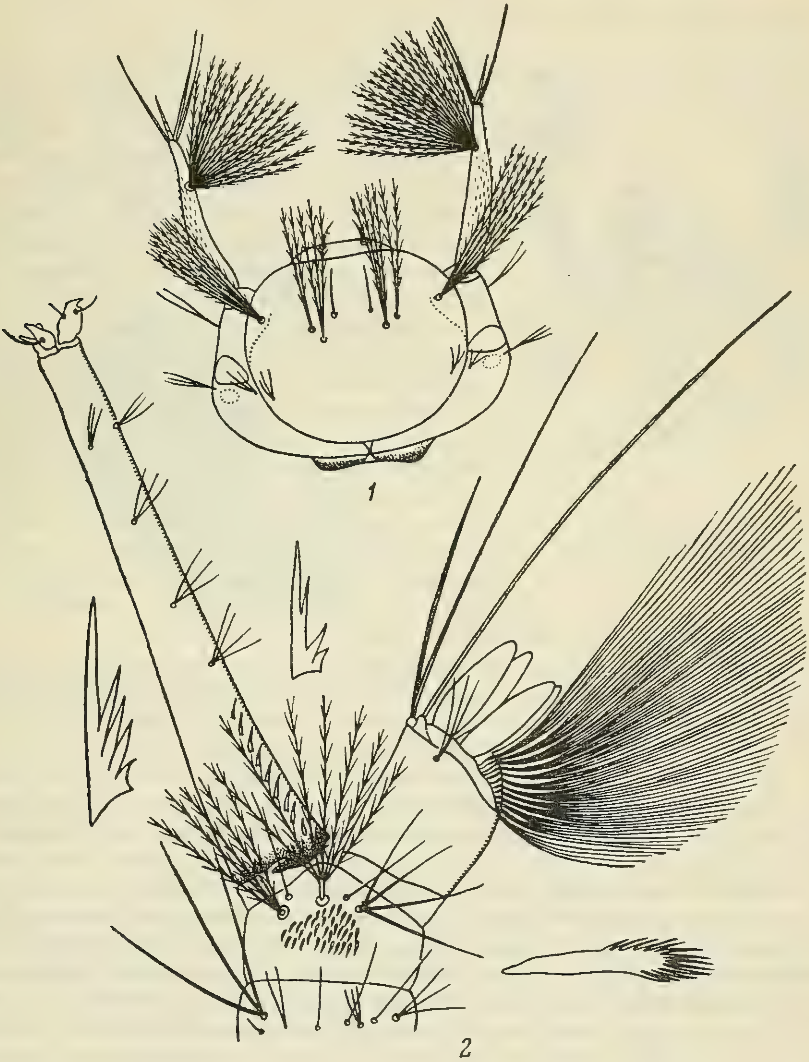

FIGURE 252. Culex univittatus Theob. Fourth-stage larva (after Edwards): 1 – head, dorsal; 2 – posterior end, lateral.

Distribution. Ethiopian region and Mediterranean, Iran, Pakistan, India. USSR: Turkmenia.

Biology. The larvae occur in stagnant water bodies with fresh or slightly brackish water with up to 0.2% salt and a pH of 7.2–9.7. They are often found together with larvae of C. laurenti Newst., more rarely with those of C. pipiens, A. caspius and A. pharoensis Theob. The females feed mainly on birds.

Epidemiological importance. A vector of West Nile virus.

17. Culex (Culex) theileri Theobald, 1903

A large species with light longitudinal stripes on the anterior surface of femora and tibiae.

(361)

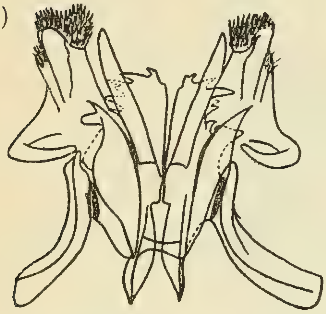

FIGURE 253. Hypopygium of Culex theileri Theob. Inner sclerites.

Head with white or yellowish contiguous scales and brown upright scales. Proboscis with brown scales and with more or less numerous white scales. Palps of female with brown scales, with a few white scales dorsally. Palps of male with brown scales, with more or less numerous spots of white scales which sometimes form rings. Mesonotum with brown scales, strongly varying in coloration; area before the scutellum with whitish scales. Legs: femora and tibiae with brown scales anteriorly and a distinct longitudinal stripe of white scales, with white scales posteriorly. Wings with brown scales. Abdomen with blackish brown scales, with a stripe of white scales at the base of the tergites usually triangularly produced posteriorly so that they form a light median longitudinal stripe with light scales ventrally.

Hypopygium (Figure 253: subapical lobe of coxite with a relatively broad, elliptical plate; style sickle-shaped; 10th sternite with a well developed basal appendage; phallosome with numerous small denticles.

Fourth-stage larva (Figure 254) transparent or yellowish, often
361 with a dark head. Frontal hairs secondarily feathered, long, outer hairs with 7–9 branches, median hairs with 2–3 branches, situated before the inner hairs and more strongly branched, inner hairs with 3–5 branches. Antennae $^3/_4$ as long as head, with darker base and apical part. Hair tuft with 25–30 branches; subapical setae situated near the apex, as long as the tuft and the apical seta. Comb with 30 or more scales, with weakly developed apical spine. Siphon nearly straight, tapering apically, index 5.5–6. Pecten extending slightly beyond basal quarter of siphon, with 6–11 widely spaced, spine-shaped denticles. with 3–5 short accessory denticles at the base. Five pairs of hair tufts, beginning at the second third from the base: 3 basal pairs longer, with 4–8 branches, situated on the posterior surface of the siphon, often in a zigzag row, 4th pair situated on the lateral surface, with 2–4 shorter branches, the 5th pair situated near the apex, on the posterolateral surface, with 2–4 short branches. Main tracheal trunks with

oval cross section. Stigmal plate of the C. pipiens type. Last abdominal segment with simple outer caudal hairs, which are longer than the siphon, inner hairs with 4 branches, lateral hair short, simple. Fin usually with 14 well developed tufts. Gills as long as or slightly longer than the saddle, with pointed end, both pairs of about the same length.

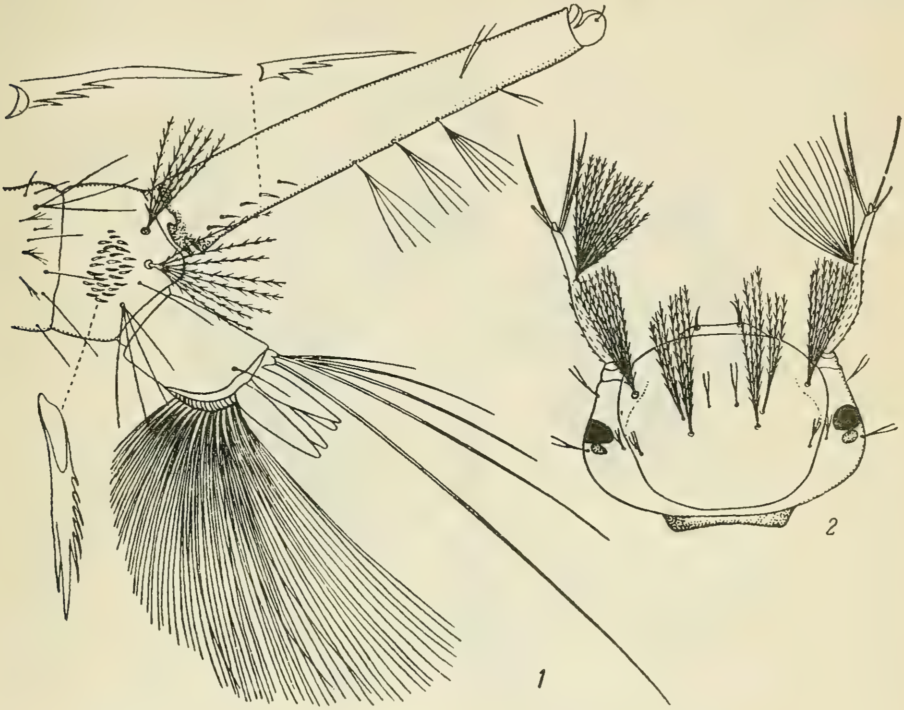

FIGURE 254. Culex theileri Theob. Fourth-stage larva (after Edwards):

1 — posterior end, lateral; 2 — head, dorsal.

362 Distribution. Ethopian region, Mediterranean and western parts of the Oriental region (India). USSR: Ukrainian steppes, Crimea, Caucasus and Transcaucasia, Middle Asia.

Biology. The larvae occur in stagnant water bodies and ditches overgrown with vegetation, often in strongly polluted water, usually in fresh or slightly saline water (to 0.2%), but the salinity is often 0.5–1.0%, pH 9.5). They occur in spring on flooded meadows. The mosquitoes bite mainly in the open, sometimes in large numbers (for example, in some parts of Armenia), sometimes entering houses and other buildings.

18. **Culex (Culex) vagans** Wiedemann, 1828 (**exilis** Dyar, 1924)

It resembles C. theileri to some extent, specimens with a weakly developed light stripe on the fore and mid-femora and tibiae resemble C. pipiens. It differs distinctly from both species in the structure of the hypopygium. C. exilis Dyar, 1924, described from Vladivostok, is a synonym of C. vagans Wied.

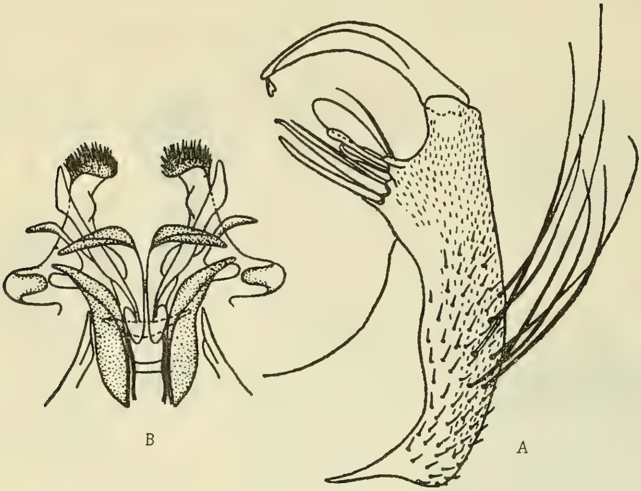

FIGURE 255. Hypopygium of Culex vagans Wie.

A — coxite and style; B — inner sclerites.

Head with yellowish or light brownish scales. Proboscis brown, usually with some light scales in the middle; palps of female dark, with a few light scales dorsally; palps of male longer than the proboscis by about the length of their last segment; long segment of palps of male dark, with some light yellow scales; terminal segments of palps not thickened. Mesonotum brown, with brownish scales with a bronze or yellowish tone, lighter laterally. Legs dark on the dorsal surface, light on the ventral surface; fore and mid-femora and all tibiae with a white longitudinal
363 stripe anteriorly, rarely with a white longitudinal stripe also on the fore femora. Abdomen with dark scales and distinct stripes of yellowish white scales at the base of the tergites dorsally; the stripes are more or less triangularly produced posteriorly in some specimens, so that they resemble C. theileri.

Hypopygium (Figure 255) with a relatively broad plate on the subapical lobe of the coxite; phallosome divided into 2—3 plates in the apical part, one plate directed distally; 10th sternite with a basal appendage.

Fourth-stage larva (Figure 256) yellowish brown, with dark head and siphon. Head usually 1.5 times longer than wide. Frontal hairs secondarily feathered, outer hairs with 6–11, median hairs with 4–6, inner hairs with 5–7 branches, both last pairs situated close together, the inner hairs more closely. Antennae about $^{2}/_{3}$ as long as the head, brown, darker at the base. Hair tuft situated at $^{2}/_{3}$ to $^{3}/_{4}$ of the length of the antenna from the base, with 25–30 branches; branches turned inward more strongly feathered. Subapical setae situated at the apex, slightly shorter than the apical seta.

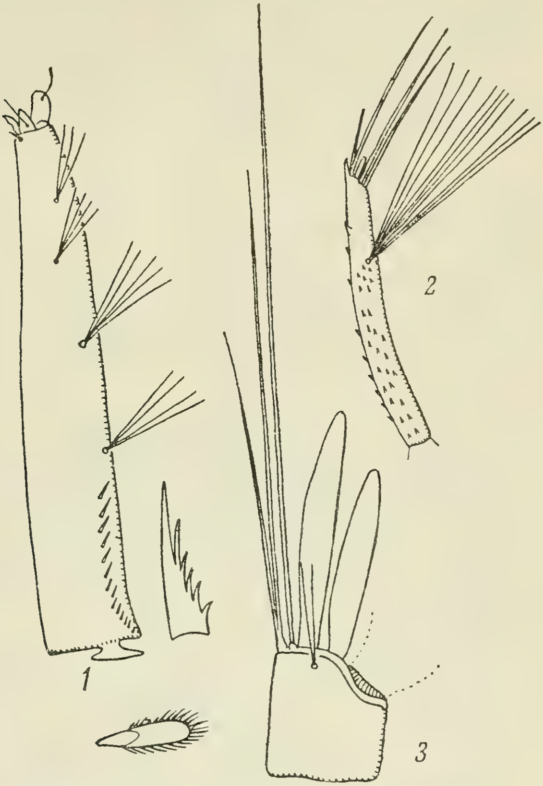

FIGURE 256. Culex vagans Wie. Fourth-stage larva (after Barraud):

1 — siphon, lateral; 2 — antenna; 3 — last segment, lateral.

Comb with 37–40 (24–47) scales with thin spines at the margin which are longer at the apex. Siphon (index 5–6) tapering from second third of antenna, slightly more than half as wide at the apex than at the base. Pecten with 7–13 denticles, 2–4 rudimentary denticles at the base, ,occupying about $^{1}/_{3}$ of the siphon, the distal denticles more widely spaced. Five pairs of of hair tufts, the 3 basal tufts longer, at least 1.5 times longer than the width of the siphon, with 3–4 (2–6) branches, situated on the posterolateral surface, the first pair often situated at the level of the distal denticle of the pecten, the 4th pair situated on the lateral surface, with 3 (2–4) shorter branches, 5th pair on the posterolateral surface shorter than the others, with 3–4 branches. Main tracheal trunks broad, with oval cross section. Stigmal plate of the C. pipiens type. Last segment of abdomen with simple outer caudal hairs which are longer than the siphon, inner hairs with 2 branches, lateral hair with 2 branches. Fin with 12 tufts, slightly longer than the gills. Gills twice as long as the saddle, pointed at the end.

364 Distribution. USSR: Transbaikalia, Khabarovsk and Maritime territories. Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, India (mainly mountains and foothills).

Biology. The larvae occur in natural and artificial stagnant water bodies (puddles, ditches, rain barrels, etc.) mainly near inhabited areas, so that they are distributed in virgin parts of the taiga. They rarely bite man.

19. Culex torrentium Martini, 1925

Martini described this species, but it is often named C. exilis (Dyar, 1924); however, C. exilis was described from Vladivostok, where C. torrentium does not occur, as far as is known. C. exilis Dyar, as stated above, is a synonym of C. vagans Wied. The relationship of the two forms and its relation to the C. pipiens complex (see below) is not clear. The hypopygia of C. torrentium and C. vagans are practically indistinguishable, but they differ distinctly in coloration: C. vagans has longitudinal stripes of white scales on the anterior side of the femora and tibiae which are absent in C. torrentium, but this development of the stripes is variable. There are specimens with indistinct stripes which are almost indistinguishable from C. torrentium. C. torrentium should possibly be considered as a subspecies of C. vagans, particularly as both forms are similar ecologically.

However, there is the question of its relation to C. pipiens. C. torrentium and C. pipiens differ distinctly in the structure of the hypopygium: the basal processes of the 10th sternite are well developed in C. torrentium. There are rarely some specimens with weakly developed processes which are apparently intermediate between C. torrentium and C. pipiens. Other differences described (coloration of mesonotum and abdomen, length of the stem of the radial fork) do not give reliable differences, to judge from our material.

There are 3 possibilities: a) to consider pipiens–torrentium–vagans as the same species; b) to consider torrentium as a western subspecies of vagans; c) to consider them, as is usual, as 3 different species: C. pipiens (cosmopolitan), C. torrentium (Europe, Siberia) and C. vagans (Siberia, Far East of the USSR, China, Japan). We are inclined to accept the last view until the problem has been studied in detail (the study should be made in East Siberia, where apparently all three forms occur).

C. torrentium closely resembles C. pipiens (see below) from which it differs only in the structure of the hypopygium. The body and scales of C. torrentium are darker; the mesonotum is covered with yellowish brown scales, usually without the golden tone characteristic for C. pipiens. The femora and tibiae are dark brown anteriorly, without light scales. The scales on the abdomen are nearly blackish brown. The scales on the light stripes on the abdomen are more distinctly white than in C. pipiens.

The structure of the hypopygium closely resembles that of C. vagans (Figure 255). The 10th sternite has a long basal process, the phallosome has 3 plates at the apex, one directed distally and the other two laterally.

Other differences described make it possible also to distinguish the 365 females: coloration of sternites, position of cross-veins, and especially, length of the radial fork: the stem of the fork is longer in C. torrentium, the fork 3–4 times as long as the stem; the stem is shorter in C. pipiens, the fork 5–6 times as long as the stem. Examination of a large material from different localities shows that these differences overlap and are not constant because of the wide variation of C. pipiens. In a specimen in the collection of the Zoological Institute, identified by Martini ("C. torrentium, Saratov, April 1925, E. Martini"), the stem of the radial fork is very short and the specimen should therefore be identified as C. pipiens.

Fourth-stage larva yellowish brown, with moderately broad head. Median frontal hairs situated before the inner hairs, much more widely spaced, usually with 5 branches. Antennae with a tuft of 20 and more branches which are $^2/_3$ as long as the antenna. Subapical setae situated near the apical seta.

Comb with 35–40 scales with a row of spines at the margin that are longer at the apex. Siphon (index 6–7) tapering from the second third. Pecten with 12 denticles, occupying about $^1/_5$ of the length of the siphon from the base. Four pairs of hair tufts with 2–3 branches are situated on the posterolateral surface of the siphon, the apical pair is the most lateral, the first 3 pairs 1.5 times as long as the width of the siphon at the base, the 4th pair distinctly shorter. Tracheal trunks broad, with oval cross section. Stigmal plate of the C. pipiens type. Last abdominal segment with long, simple outer caudal hairs and 2-branched inner hairs. Fin with 11–12 tufts. Gills lanceolate, twice as long as the saddle.

Distribution. Widespread in the USSR: Leningrad, Perm, Sverdlovsk, Orenburg regions, Urals, Lower Volga area, Crimea, Northern Caucasus, West Siberia and other regions. Central Europe, Asia Minor.

Biology. The species was confused with C. pipiens in the past because its ecology had not been studied in detail. The larvae occur in different types of water bodies. In the Lower Volga area, they are found in small water bodies with rich vegetation, in floodplains of rivers; in Central Europe (Black Forest) they occur in rock pools along mountain streams together with larvae of Culiseta glaphyroptera. It is not synanthropic. It apparently bites man very rarely.

20. Culex (Culex) pipiens Linnaeus, 1758 (Figure 257)

Head with brown scales; lateral parts of head and posterior margin of eyes usually with white scales. Proboscis brown. Palps of female with brown scales, sometimes with white scales in the middle and at the apex.

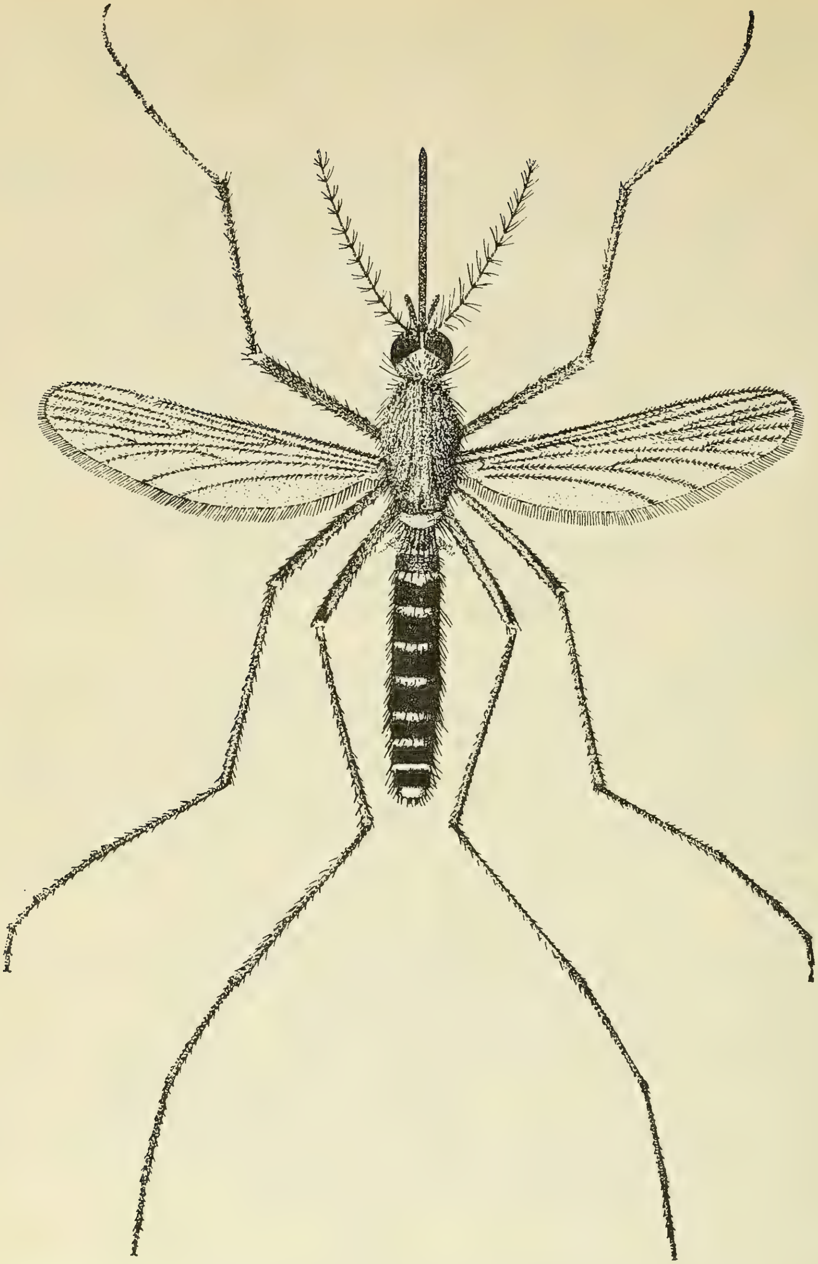

FIGURE 257. Culex pipiens L.

Palps of male distinctly longer than the proboscis, with brown scales; two terminal segments with white scales ventrally; dark brown, bristlelike hairs at the apex of segments 3–5 of palps well developed; more or less distinct rings of white scales on long segment of palps. Mesonotum with reddish brown or yellowish brown scales: lateral margins of mesonotum and area before the scutellum with lighter scales; pleurae of thorax with indistinct spots of white scales on the proepisterna, sternopleura, and mesepimera. Legs with brown scales, femora with yellowish white scales ventrally. Wings with brown scales. Abdomen with dark brown scales and more or less broad stripes of light yellow or whitish scales at the anterior margin of the tergites. These stripes are rarely absent.

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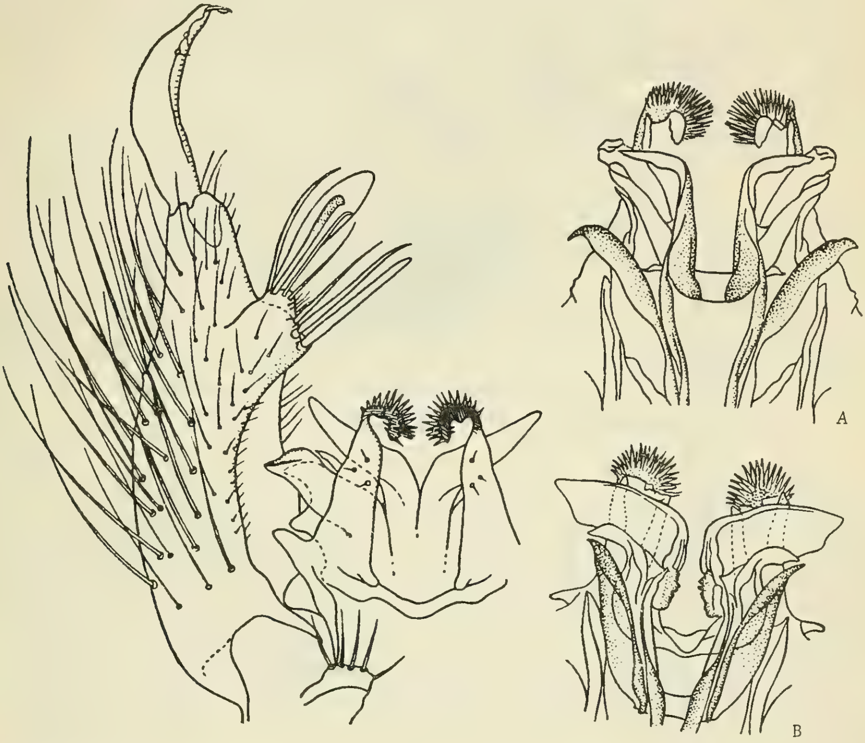

FIGURE 258. Hypopygium of Culex pipiens L. (after Coe, Freeman and Mattingly):

A — inner sclerites of C. p. pipiens L.; B — same of C. p. fatigans Wied.

Hypopygium (Figure 258): subapical lobe of coxite with a broad plate with rounded apex; second part of phallosome simple, not divided, without denticles; basal process of 10th sternite absent or forming a small, rod-shaped or triangular process; it is rarely larger, but in distinction to C. torrentium, it is not curved or sclerotized.

Fourth-stage larva (Figure 259) very variable in coloration, grayish yellow to yellowish brown; with yellowish or brown head and siphon. Medium-sized, rarely large.

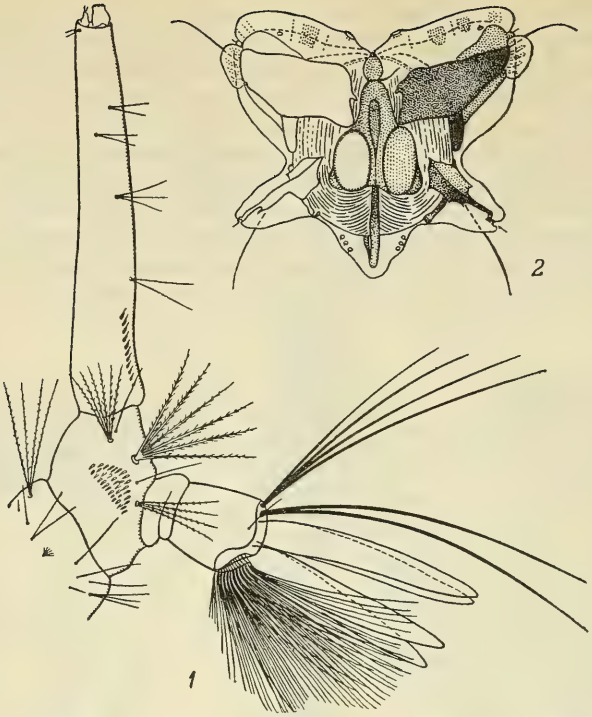

FIGURE 259. Culex pipiens pipiens L. Fourth-stage larva: 1 — posterior end, lateral; 2 — stigmal plate.

Head 1.3 times wider than long. Frontal hairs well developed, secondarily feathered; outer hairs with 6—10 branches, median hairs situated before the inner hairs, more widely spaced, both pairs with 3—7 (average 4) branches. Postclypeal hairs short, simple, situated between the median frontal hairs. Antennae about 0.6—0.7 times as long as the head, more densely covered with spines in the basal part and with isolated spines in the apical third where the tuft is situated; tuft with 20—30 secondarily feathered branches, $^1/_3$ as long as the antenna. Subapical setae situated near the apex, shorter than the tuft.

Comb with 30—55 densely arranged oblong scales of varying size which form a half-round spot; scales without a main spine, with a row of spines at the margin and apex. Hairs behind the comb: dorsal hair with 3—7, ventral hair with 3—6, the longest median hair with 6—10 secondarily feathered branches; intermediate hairs shorter, simple. Siphon of varying length and form (index 4—6.5), nearly straight, widest at the base or slightly curved and wider in the middle. Pecten occupying about $^1/_5$ — $^1/_4$ of the length of the siphon, with 9—18 closely spaced denticles, 1—3 denticles near the base rudimentary.

368 Four pairs of hair tufts on the siphon (rarely 3 or 5 pairs), situated at the sides of the posterior surface. First pair near the base situated slightly distal to the distal denticle of the pecten, with 3–8 branches, first pair of tufts situated close together. Second pair in middle of siphon situated more laterally, with 2–7 branches, 3rd pair with 2–7 shorter branches situated most laterally, 4th pair the shortest, with 2–5 branches, situated like the 2nd pair. Tufts shorter than the width of the siphon at their position or distinctly longer.

Main tracheal trunks broad, ribbon-shaped, at least half as wide as the siphon. Stigmal plate (Figure 259) slightly wider than long. "Stirrup" broad, with a large cavity, narrowing between the spiracles and forming an anterior arc which extends far beyond the middle of the spiracles. Posterior arc rounded, with a long chaetoid with a broad base. Behind it is a posterior appendage forming an irregularly oval, slightly pigmented plate, darker at the distal end where the posterior valves are attached. Spiracular processes of "stirrup" weakly developed.

Spiracles with strongly inward narrowing openings and deeply invaginated inner margin, following the curve of the "stirrup" and with thickened and strongly projecting distal anterolateral margin.

369 Anterior valves more strongly chitinized only in the middle in two stripes on their upper and lower surface. Organs on lateral valves with broad base ending in process a directed toward the spiracles.

Last segment short, slightly longer than wide. Saddle surrounding the segment like a ring, with a short, simple lateral hair. Outer caudal hairs 2-branched (rarely simple), 1.5–2 times as long as the gills, inner hairs with 2–4 shorter branches, the ventral branch the longest. Fin usually with 12 tufts, the longer, posterior tufts longer than the gills or as long as these. The last tufts as long or longer than the saddle, sometimes twice as long.

Note on systematics.* The species of the Culex pipiens complex form a polytypical species, including some intraspecific forms which differ morphologically and biologically to a varying degree (Jobling, 1938; Mattingly et al., 1951); Seminar on the Ecology, Biology and Control of the Culex pipiens complex, 1965). The complex included originally C.p. pipiens L., C.p. fatigans Wied. and C.p. molestus Forsk. More detailed studies in different parts of their distribution showed that there are populations with intermediate morphological characters and different combinations of biological characters which were given different names, e.g., C.p. pallens Coq. C.p. australicus Dobr. and C. globocoxitus Dobr. were recently described from Australia. The taxonomic status and systematic position of the latter are not clear. C.p. australicus occurs only in Australia, mainly in rural areas. It resembles C.p. pipiens biologically and the intermediate forms obtained by the crossing of C.p. fatigans and C.p. pipiens morphologically, although the latter species has not been recorded from Australia.

C.p. fatigans (it is often named C.p. quinquefasciatus Say in the American literature) differs distinctly from the other forms in the width of the second part of the phallosome of the male and in the structure of the siphon of the larvae. The species copulates in a small space (stenogamous)

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* Written by E.B.Vinogradova; for details see Vinogradova (1965, 1966, 1969).

and there is no diapause (homodynamic). The morphological differences between C.p. pipiens and C.p. molestus are quantitative, but they are significant biologically: C.p. molestus is homodynamic, stenogamous and the first egg-batch may develop without a blood meal (autogenous); C.p. pipiens has a diapause (heterodynamic), a large space is required for copulation (eurygamous), and the eggs develop only after a blood meal. The morphological differences between these two forms are small in the adults (coloration, relative length of the proboscis and first 4 segments of the the palps of the male) and in the larvae (siphonal index, number of branches of the tufts of the siphon, branching of hairs, etc.). The best diagnostic character of the larvae, the siphonal index (at most 4.5 or less in C.p. molestus, more than 4.5 in C.p. pipiens) shows marked variation which is continuous but not clinal. There are often micropopulations in the same breeding place which differ distinctly in the mean of the siphonal index. The temperatures during development may have a slight influence on the siphonal index. There may also be a combination of variations (natural hybridization) which has probably taken place in some intermediate populations. Such a high degree of variation in morphological characters makes the determination of the subspecies of a specimen often difficult or impossible. The reliability increases if a series of specimens is examined (mean values of quantitative characters supplemented by morphological and biological characteristics which are of decisive importance in distinguishing C.p. pipiens and C.p. molestus).

During studies of the C. pipiens complex, the taxonomic status of its forms has been differently interpreted. C.p. fatigans was considered for a long time as a different species, but it is considered as a subspecies at present. A more complicated problem is C.p. molestus (some authors, e.g., French authors, name it C.p. autogenicus Roubaud). The 370 numerous biological differences between C.p. pipiens and C.p. molestus were the reason that some authors considered C. molestus as a different species, but this is not generally accepted at present. C.p. pipiens and C.p. molestus are increasingly being considered as subspecies of C. pipiens, including the autogenous and anautogenous forms, because they cannot be distinguished by morphological characters and because of the existence of many intermediate forms (further details will be given below). We agree, but we think that it would be useful to give below the biological characteristics of the extreme typical forms C.p. pipiens and C.p. molestus.

In addition to the subspecies mentioned above, there are intermediate forms of the complex in different parts of the distribution which have a varying stability. C.p. pallens combines the characters of C.p. pipiens and C.p. fatigans and was found in a wide zone adjacent to the area of the above subspecies in North America (between 39° and 36°N) and in the Far East. It shows intermediate morphological characters, particularly the moderately broad second part of the phallosome. Its Far Eastern populations form long lived, stable populations, but the North American forms are possibly seasonal.

Hybrids between C.p. molestus and C.p. fatigans are known from Australia; their appearance is restricted in some localities to the summer-autumn period, and their elimination to the winter.

The forms intermediate between C.p.pipiens and C.p.molestus are widespread in nature, mainly in the southern parts of the Palaearctic, North Africa, France, Italy, USSR (Crimea, Northern Caucasus, Transcaucasia). They usually show intermediate morphological characters (mean values of the siphonal index of the larvae 4–5) and combinations of biological characters. Some authors, particularly Roubaud and Ghelovitch, 1956; Rioux, 1958, and others have named these biotypes: C.p.berbericus Roubaud (stenogamous, anautogenous, anthropophilic and homodynamic). We do not think that this is advisable because the possible number of combinations of biological characters is quite large and may result in complication of the terminology. The anthropophilic populations of C.pipiens in the USSR are of practical and scientific interest. Mass attacks on people have been observed in Moscow, Rostov-on-Don, Odessa, Krasnodar, Stavropol, Novorossiisk and other localities.

The development of populations with intermediate characters is of interest. Most authors consider some, if not all, populations as of hybrid origin. Evidence of this are the many experiments in crossing these forms which produce fertile progeny, e.g., an experimental generation of C.p.pallens. The tracing of morphological and biological characters (siphonal index of the larvae, structure of the hypopygium, autogenesis, stenogamy) also conforms with this view.

During the development of C.p.pipiens and C.p.molestus, the adaptation of C. molestus to existence in the human environment was of first importance. In temperate climates and harsh winters, the existence of both forms, of the form with a diapause (C.p.pipiens), is possible, or the existence of the homodynamic form (C.p.molestus), which is restricted to specific ecological niches like warm cellars and similar habitats in which they reproduce throughout the year. The existence in closed habitats also facilitates the selection of autogenous and stenogamous forms, which has been confirmed experimentally and in nature. The morphological and biological differentiation of the two subspecies increases further north. This is probably connected with climatic factors.

Culex pipiens pipiens L.

Mesonotum usually with reddish brown scales. Second part of phallosome narrow, hook-shaped (Figure 258, A).

Fourth-stage larva (Figure 259) with very variable characters in 371 external habitus and branching and development of hairs. The branching of the hairs in the nominate subspecies is usually weaker but this cannot be determined on individuals but has to be determined by examination of a large material. The median and inner frontal hairs are 3–5-branched (average 4 branches). Median hair behind the comb with 6–8 branches. Hair tufts on siphon (counted from the base): first tuft with 3–4, 2nd and 3rd tufts with 2–3, 4th tuft with 2–4 branches.

Siphon straight, slightly curved in the middle but not widened, tapering apically, longer than in the other subspecies (index 4.5–6.4, average 5.3–5.4).

Last segment relatively short, slightly longer than wide. Outer caudal hairs usually 1.5 times longer than the gills, with 2 branches. Ends of the longest posterior tufts of the fin reaching to the end of the gills but not projecting beyond them. Gills lanceolate, with pointed end, distinctly longer than the saddle; both pairs of the same length.

Distribution. It occurs mainly in temperate climates. Palaearctic, northern half of North America, North Africa; rarely found in West Africa. The disturbance of the normal process of mating probably prevents its occurrence in the tropics. It is distributed throughout the USSR in river valleys and in inhabited areas, nearly to the Arctic Circle. It is rarely east of Lake Baikal.

Biology. The larvae are found in the most diverse natural and artificial stagnant water bodies, swamps, shallow parts of large water bodies, ditches, pools, puddles, irrigation ditches, rain barrels, reservoirs. They prefer clean water but sometimes develop in polluted water. The breeding places are not always connected with inhabited areas. They have a large vertical distribution, to 2,000–2,500 m in the Talysh and western Pamirs. They occur from May and in more southern regions from March to September-November. They reach maximum numbers in late summer. Two or more generations per year in the South. Fertilized females hibernate in diapause in all possible natural shelters and in unheated cellars and basements. The numbers of hibernating females may be very large. Continuous development throughout the year probably takes place in the southern parts of the distribution. The adults are eurygamous, requiring a large space for copulation. The eggs develop only after a blood meal. This subspecies feeds only on birds. Many authors have observed that they are practically absent among mosquitoes biting man. Attacks on man are more frequent in southern regions, but reliable determination of the subspecies of biting mosquitoes is difficult. Laboratory observations confirm that the southern forms are more aggressive to man than the northern forms.;

Their role as vectors of diseases is not clear. C. p. pipiens has been considered as a vector of western equine encephalitis and St. Louis encephalitis in North America, but the determination of the subspecies is doubtful.

372 Culex pipiens molestus Forskal, 1775

Indistinguishable from C. p. pipiens by morphological characters and coloration.

Fourth-stage larva (Figure 260), also very variable, but the branching of the hairs is usually stronger. Median and inner frontal hairs with 4–6 (average 5) branches. Median hair behind the comb with 6–10 branches. Hair tufts of siphon (counted from the base): first tuft with 3–8, 2nd and 3rd tufts with 2–7, 4th tuft with 2–5 branches.

Siphon relatively shorter than in the nominate subspecies (index at most 4.5) and tapering slightly more strongly apically but not widened in the middle.

Last segment longer than in the nominate subspecies. Outer caudal hairs twice as long as the gills or longer, although they are absolutely shorter than in the nominate subspecies. Gills as long as or shorter than the saddle, upper pair longer than the lower.

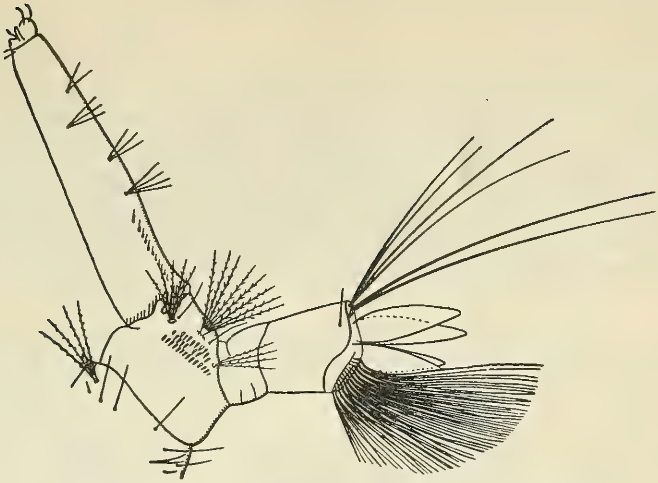

FIGURE 260. Culex pipiens molestus Forsk. Fourth-stage larva. Posterior end, lateral.

Distribution. C.p.molestus is sympatric with C.p.pipiens; the only exception is Australia, where only C.p. molestus occurs (introduced). C. p. molestus is distributed at present in many cities in Europe, Asia, Africa and America; England, Sweden, Norway, Poland, France, Germany, Czechoslovakia, Italy, Egypt, Israel, Sudan, Japan. In the USSR it has been found in Leningrad (Fedorov, 1941), Vologda, Moscow, Kiev, Kharkov, Dnepropetrovsk, Donetsk, Krasnyi Liman, Nikolaev and Baku. It bites people in hot countries and in years of mass reproduction in temperate climates.

Biology. The larvae occur in temperate climates in water in cellars and attics (mainly in localities where reproduction continues throughout the year), also in rain barrels and other artificial receptacles near houses 373 (summer and early autumn). They may develop throughout the year in open water bodies in the tropics and subtropics. The larvae prefer strongly polluted water and stagnant water in sewers, but they may also develop in less polluted water. Several generations per year. The females do not undergo diapause. The adults are stenogamous, the minimum space necessary for copulation is 27 cm^3. Often used in the study of stenogamy are the cages of Frizzi (5 dm), of Roubaud (26 dm) and of Bates (337 dm). The females are autogenous (the first egg batch is deposited without a blood meal at the expense of larval reserves). If the larvae are badly fed, autogeny is present only in a few females. The structure of the ovaries in young, recently hatched females is characteristic: the first follicles are usually in different stages of development, giving a mosaic picture. Autogeny is an inherited character.

Epidemiological importance. C.p. molestus is a vector of West Nile virus.

Culex pipiens fatigans Wiedemann, 1828 (quinquefasciatus Say, 1823)

Closely resembling C. p. pipiens in coloration, differing in the yellowish brown, not reddish or dark brown scales on the mesonotum; palps of males less densely covered with hairs; transverse stripes on abdominal tergites yellowish, usually narrowing laterally, as a rule half-moon-shaped. It differs distinctly from C. p. pipiens in the structure of the phallosome (Figure 258, B), the second part of which is lobe-shaped and very wide (it is narrow, hook-shaped in C. p. pipiens). The females of the two subspecies cannot be distinguished with certainty.

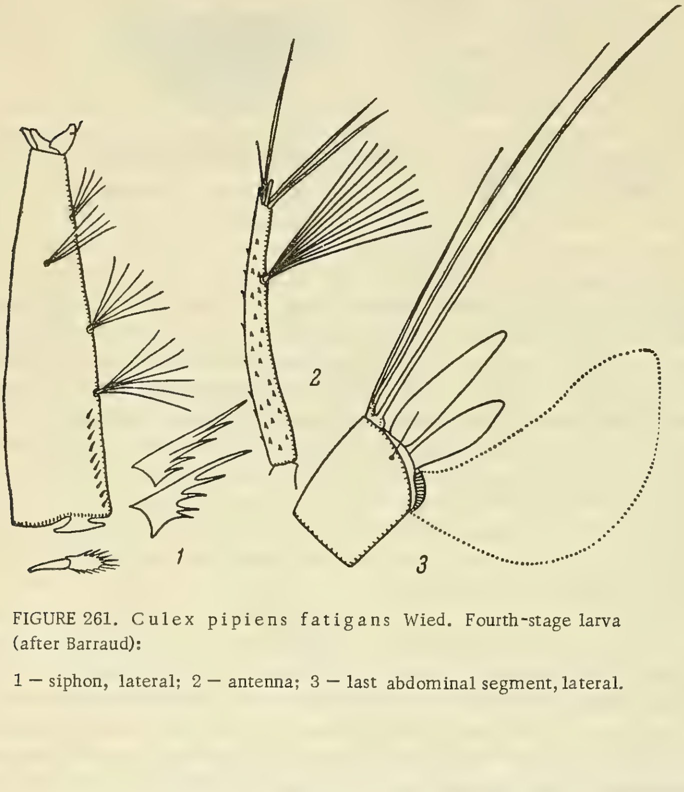

FIGURE 261. Culex pipiens fatigans Wied. Fourth-stage larva (after Barraud):

1 — siphon, lateral; 2 — antenna; 3 — last abdominal segment, lateral.

374 Fourth-stage larva (Figure 261) differing from that of the other subspecies mainly in the form of the siphon, in which the anterior surface is distinctly convex and the posterior surface is convex in the middle and slightly concave (rarely straight) in the tapering part near base and apex. The maximum width of the siphon is therefore not at the base but in the middle. The width at the apex of the siphon is slightly more than half the width at the base. The tufts on the siphon are usually more strongly branched than in the two other subspecies: the 2 pairs near the base with 6—7 branches, as long as or slightly longer than the width of the siphon at their position. The other hairs of the body, particularly the frontal hairs, are more strongly branched than in the larvae of the other subspecies

(median and inner hairs with 5–7 secondarily feathered branches). Gills as long as saddle or longer.

Distribution. It occurs throughout the tropics and subtropics. Not recorded with certainty from the USSR.

Biology. The larvae occur in artificial water bodies in towns and sparsely inhabited areas, rarely in natural water bodies. They may develop in strongly polluted water. This gives them a distinct advantage over other species of mosquitoes in a biocenosis. Their recent rapid increase in numbers in the tropics and subtropics is connected with urbanization, which has created favorable conditions for their reproduction. The adults are stenogamous. Several generations per year without diapause.

A blood meal is necessary for the development of the eggs. The range of hosts for food is broad, but different populations vary in this respect. C. fatigans feeds mainly on man and is a vicious bloodsucker in some parts of its distribution.

Epidemiological importance. It is an important vector of filariasis caused by Wuchereria bancrofti, a vector of Brugia malayi and Dirofilaria immitis and also of some plasmodia of birds. It is a vector of St. Louis encephalitis and of western (equine) encephalitis in America. It also transmits Japanese encephalitis.

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